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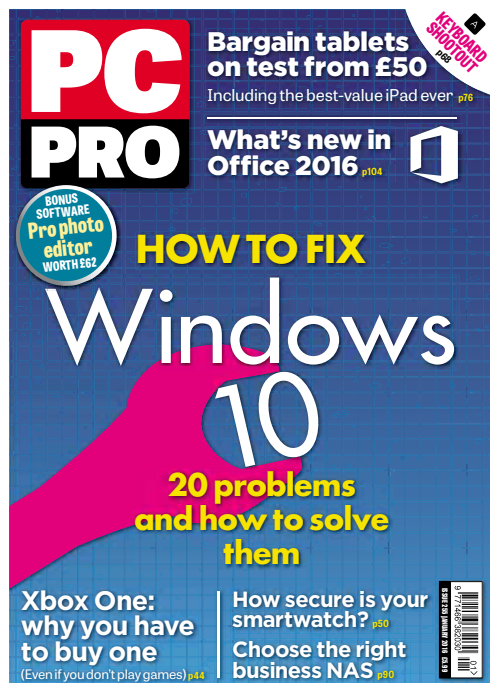
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Editor's letter

No way to make a living

I WORKED IN AN OFFICE FOR 16 YEARS: an office an hour and a half from my home, once you take into account the bike ride, train journey, bus ride, and all the waiting and walking in between. And the reverse applies for the home trip. That's a fifth of my waking hours swallowed by the commute.

But you'll notice the past tense, because all of that changed a few weeks ago when I switched to a completely different approach. I'm now living the remote working dream, not the come-into-the-office-come-hell-or-high-water vision that became fashionable back in the day when Dickens created Ebenezer Scrooge.

Why did I stick to that routine for so long? And why, assuming you're still doing the 9 to 5 immortalised by Dolly Parton, do you? I fully appreciate that all jobs are different, but take a close look at your daily tasks. Do you really need to come into the office? Could you be more effective from home? Or in Barcelona, come to that.

Then extend that to people you work with. Do they need to be there all the time? Will they be happier if you let them work remotely? Will they stick in their job with you for longer? Can your business save money by subletting some of the office, or shifting to a smaller one?

For some industries, there's much less opportunity to make this work. Manufacturing, retail and healthcare all immediately spring to mind, because the value of employees comes from one human physically helping another, as in retail or healthcare, or taking advantage of specialist facilities – welding machines, for instance, rarely sit well next to an Ikea desk in a home office.

But those jobs are exceptions. We haven't noticed that technology has either produced a good substitute for meetings or replaced it with something better.

A good example, in the *PC Pro* office at least, is Slack. So far today, I've exchanged 20 messages with Monica, our production editor (some of them have even been about work). Whilst it isn't as nuanced a communication medium as actually talking to someone, it's arguably a better way to exchange information – by which I mean Monica telling me what to do – than verbally. Plus, it's all written down for later reference.

We have Google Drive as a shared repository for files, which anyone who's working on the magazine has access to. There's Google Docs if we need to work on a document together. Email is a last resort.

I'm sure that, in many cases, I'm preaching to the converted. But I'm equally sure others will say it could never work for them. What about when you need to bring together everyone who's working on a project? I definitely recognise that, which is why I'm still coming into the office once or twice a week. It does mean co-ordination of diaries, but that's achievable.

The bigger hurdle, though, is trust. Does your boss trust that you will be working if he can't see you sitting at your desk? Likewise, can you trust your employees? But does it matter? Surely what any business needs is for products to be created, projects completed, things to be sold, marketed and bought. They're tasks that need to be done – and that's why you employ staff. Whether they're physically sitting at their desks or not is as relevant as the colour of their socks. If, by heck, they choose to wear any at all.

Tim Danton
Editor-in-chief

CONTRIBUTORS



Jon Honeyball Apple's recent "Chipgate" scandal offered a rare glimpse into the grubby inner workings of the phone production and distribution process, explains Jon on **p130**



Alan Richards Microsoft promises that Office 2016 "takes the work out of working together". To find out what this means in practice, read Alan's guide on **p104**



Adam Banks Brand-new consumer-protection laws will change the way we buy software, apps and digital downloads. Adam reveals whether it's really a win for the users on **p16**



Tom Arah If you need cheap, but good, images for your site or marketing, Adobe reckons it has the answer with Stack. Tom reveals if it's really such a bargain on **p116**

EDITORIAL

EDITOR-IN-CHIEF

Tim Danton: editor@pcpro.co.uk

DEPUTY EDITOR

Darien Graham-Smith

REAL WORLD COMPUTING EDITOR

Dick Pountain: rwc@pcpro.co.uk

BRIEFING & FUTURES EDITOR

Nicole Kobie

REVIEWS EDITOR

Jonathan Bray: reviews@pcpro.co.uk

ONLINE EDITOR

David Court

ONLINE TEAM

Ian Betteridge, Vaughn Highfield, Alan Martin,
Thomas McMullan, Curtis Moldrich, Sasha Muller

ART & PRODUCTION

ART EDITOR

Paul Duggan

FREELANCE DESIGN

Bill Bagnall, Sarah Ratcliffe

PRODUCTION EDITOR

Monica Horridge

SUB-EDITORS

Max Figgitt

CONTRIBUTING EDITORS

Tom Arah, Steve Cassidy, Barry Collins, Jon Honeyball,
Dave Mitchell, Stewart Mitchell, Mark Newton,
Paul Ockenden, Kevin Partner, Nik Rawlinson, **Davey Winder**

CONTRIBUTORS

Stuart Andrews, Adam Banks, Ben Pitt,
Alan Richards, Dave Stevenson

PHOTOGRAPHY & PRE-PRESS

Danny Bird, Henry Carter, Phil Dawson, Jenni Leskinen,
Russ Nicholas, James Walker

ADVERTISING TEL: 020 7907 6662

FAX: 020 7907 6600

SENIOR ADVERTISING MANAGER

Ben Topp: ben_topp@dennis.co.uk

SALES EXECUTIVE

Jessica Quinney: jessica_quinney@dennis.co.uk

GROUP AGENCY DIRECTOR

Paul Lazarra: paul_lazarra@dennis.co.uk

BRAND DIRECTOR (TECHNOLOGY DIVISION)

Julie Price: julie_price@dennis.co.uk

GROUP AGENCY MANAGER

Hannah Dickinson: hannah_dickinson@dennis.co.uk

STRATEGIC AD MANAGER (DIGITAL)

Matthew Sullivan-Pond: 001 646 717 9555

matthew_sullivan@dennis.co.uk

AD PRODUCTION TEL: 020 7907 6055

GROUP PRODUCTION DIRECTOR Robin Ryan

DIGITAL PRODUCTION MANAGER **Nicky Baker**

PRODUCTION CONTROLLER Anisha Mogra

CIRCULATION & SUBSCRIPTIONS

Tel: 0844 844 0083 pcpro@servicehelpline.co.uk

CIRCULATION MANAGER Emma Read

NEWSTRADE DIRECTOR David Barker

SOFTWARE DOWNLOAD TECHNICAL SUPPORT

software@pcpro.co.uk

REPRINTS TEL: 020 7907 6625

Ben Topp: ben_topp@dennis.co.uk

**What's your
favourite techie
film and why?**

"Alex Garland's *Ex Machina*,
because Oscar Isaac
captured the cool
megalomania of the tech
tycoon so perfectly."

"*The Right Stuff* from 1983,
a terrific movie about the
clash between a new breed
of pilot – the astronaut – and
the technology that
threatens to replace them."

"*Hackers*. I was offered
a small part in it, but went to
the E3 gaming convention
instead."

"*Back to the Future*.
Self-fastening Nikes and
hoverboards – you can't get
better than that. And it had
a mad scientist. And the car
used to live near me in
Crouch End."

"The original *Star Wars*
trilogy... because I wanted
to be Princess Leia and
get to snog Hans
Solo, obviously."



EDITORIAL Tel: 020 7907 6000

LETTERS letters@pcpro.co.uk

TWITTER @pcpro

FACEBOOK facebook.com/pcpro

SUBSCRIPTION ENQUIRIES 0844 844 0083

PC Pro, 30 Cleveland Street, London W1T 4JD

Dennis Publishing Ltd.

GROUP MANAGING DIRECTOR Ian Westwood

MANAGING DIRECTOR John Garewal

DIRECTOR OF ADVERTISING Julian Lloyd-Evans

FINANCE DIRECTOR Brett Reynolds

GROUP FINANCE DIRECTOR Ian Leggett

CHIEF EXECUTIVE James Tye

COMPANY FOUNDER Felix Dennis

PRODUCTION & DISTRIBUTION

Printed by BGP. Distributed by Seymour Distribution, 2 East
Poultry Avenue, London EC1A 9PT. Tel: 020 7429 4000. PC Pro is
published monthly by Dennis Publishing Limited. Company
registered in England, number 1138891.

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SUBSCRIPTIONS

Price: UK £49.99; Europe £70; Rest of World £90. Visit
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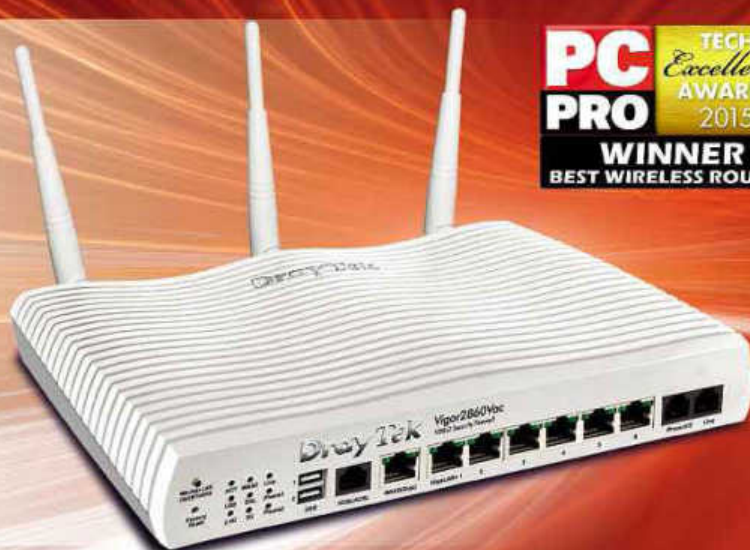
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Briefing

Background and analysis on all the important news stories

Answering the Uber question

How Uber keeps on the road, despite all its legal challenges **p13**

The rise and rise of online crime

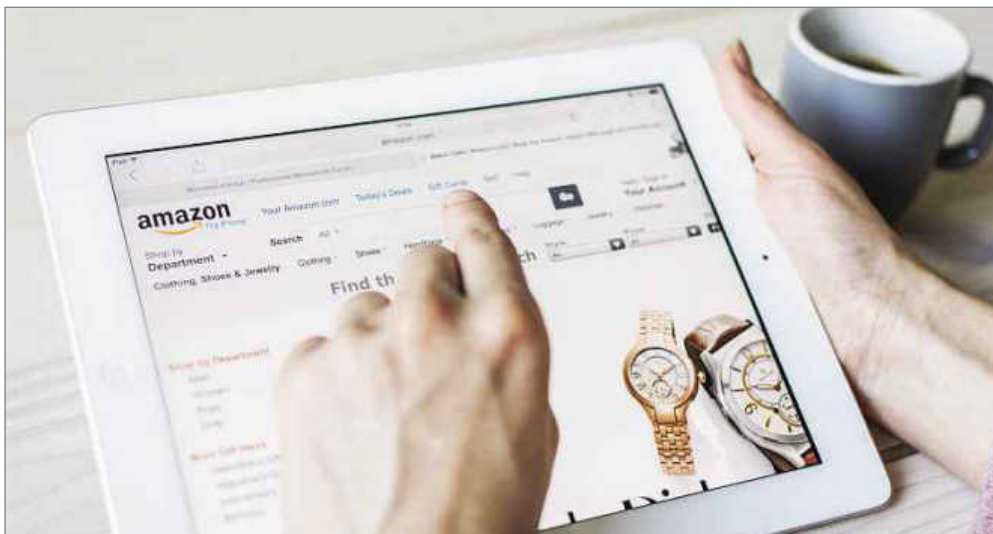
5.1 million cases, 3.8 million people affected... but at what cost? **p14**

PC Probe: buggy software

You can now claim for faults, but check the small print **p16**

Amazon gives fake reviews one-star – and a writ

The backlash against fake reviewers has begun, and those who spin lies online could face stiff penalties, **Nicole Kobie** discovers



AMAZON HAS SUED more than 1,000 people for posting fake reviews as it fights back against those sellers trying to “gain unfair competitive advantages” by paying for positive recommendations on products.

The anonymous products have sold their review-writing services via Fiverr, which lets users earn \$5 (£3.25) for small tasks. Fiverr isn’t named as a defendant, with Amazon instead targeting the individuals.

A Fiverr spokesperson said: “We actively remove services that violate our terms of use, and respond promptly to any reports of inappropriate content.” Fiverr said it restricts “reviews to only those who we can verify have actually purchased a service”.

However, at the time of publishing, multiple ads were posted on Fiverr offering to review businesses on local Google listings, iTunes, Facebook and Amazon. According to Amazon’s court filing, some don’t even write the review themselves, but simply post their client’s text.

Despite long-standing doubts about the authenticity of reviews on many sites, consumers still place a great deal of faith in the opinions of their supposed peers. “Fake reviews are certainly a concern because, of course, the sharing economy is founded in peer-to-peer trust,” said Debbie Wosskow, founder and CEO of Love Home Swap and chair of SEUK, the UK’s trade body representing sharing-economy businesses.

What can be done?

Amazon isn’t the first site to have its reputation tarnished by suspect reviews. Last year, TripAdvisor was investigated in Italy after a local newspaper set up a fake profile that, within weeks, became the best-rated restaurant in town – even though the restaurant never actually existed.

TripAdvisor spokesperson James Kay said the travel site uses a host of methods to ensure reviews were real. “Our approach is twofold: we have sophisticated systems

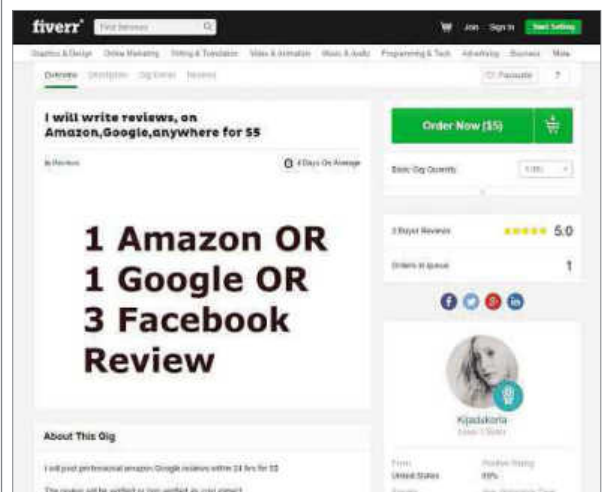
and teams to detect fraudsters, and we have strong penalties in place to deter them,” he told *PC Pro*. “Every single review goes through our tracking system, which maps the how, what, where and when of each review. We back that up with a team of over 300 content specialists. They investigate every review that is flagged for inspection by our system.”

Expensive lies

Ejection from a site isn’t the only sanction fake reviewers face if they’re caught, noted lawyer Will Richmond-Coggan from Pitmans. He pursued the first successful lawsuit against a fake reviewer in the UK, winning £50,000 in costs and £50,000 in damages.

His client, a US lawyer specialising in drink-driving cases called Timothy Bussey, had mainly positive reviews. But a negative review called Bussey a “scumbag” and claimed he paid for positive reviews, because he lost most of his cases. “This was the only review that was on there to be marked as ‘helpful’ by other users, so he could see that clients were looking at

BELOW Ads are placed on Fiverr offering to post reviews on sites such as Amazon



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☐ **EXTRA FAST** 3 days Delivery: 1 (\$20)

☐ Post a testimonial on an additional online website or review site as well (+3 days): 1 (\$10)

☐ Provide an additional comment or answer during the 1st month of your review: 1 (\$10)

☐ Ask two questions to help highlight your product or service (+4 days): 1 (\$20)

☐ Tweet your product or service twice to my 1300 followers (+4 days): 1 (\$20)

Order Now (\$5) 

the review and being deterred,” Richmond-Coggan told *PC Pro*.

After a court order forced Google to hand over the IP address of the reviewer, it was revealed that Briton Jason Page had never even been a client of Bussey’s. “But he advertised various online services through Fiverr,” said Richmond-Coggan.

“Fake reviews are certainly a concern because the sharing economy is based on peer-to-peer trust”

Bussey sued for defamation and the judge didn’t buy Page’s claims that his Google account was hacked, believing that he must have been paid to write the post. It’s never been established who paid for the critical review.

“If people are thinking of making some money out of reviews, don’t touch it with a barge pole,” warned Richmond-Coggan. “There are still risks you could be fined for posting untrue material that is effectively advertising.” ●

ABOVE Fiverr claims it restricts reviews writing to verified purchases

Five stories not to miss

1 Apple ordered to pay up over patents

A federal jury in Wisconsin has ordered Apple to pay \$234 million to a local university over a patent for circuit technology used in A7 and A8 chips, which are used in iPhones and iPads. The University of Wisconsin had previously settled with Intel over the same complaint, and claimed Apple refused efforts to license the technology.



2 Ransom demand after TalkTalk hack

Hackers have demanded a ransom payment from TalkTalk after the telecoms firm was hit by its second attack this year. Stolen data appeared to include payment card details and other sensitive personal information, but it wasn’t clear at the time of writing how many of its four million customers were affected. The Metropolitan Police is investigating.



3 Surface Book is Microsoft’s first laptop

Microsoft unveiled the Surface Book, a laptop based on its Surface Pro tablet – indeed, the 13.5in display even detaches from the keyboard base. It’s a premium device: there’s a 1TB model with a Core i7 and 16GB of RAM for \$3,200 (£2,085). UK pricing and availability haven’t been



announced, but the base model is expected to sell from around £1,200.

4 YouTube Red offers ad-free subscription

Love YouTube, but tired of seeing the same ads before every video? With a \$10 (£6.50) monthly subscription to YouTube Red, you can watch and listen without ads and download videos for offline viewing. Anyone with a Google Play Music membership will get Red for free, but so far it’s US-only; Google is promising to bring it to other countries soon.



5 Safe Harbour laws fall

The Court of Justice of the European Union has ended “safe harbour” laws, which allowed data from users in member states to be transferred to the US. If a new data-transfer deal isn’t reached by the end of the year, 4,000 companies moving European data to the US could face legal action, regulators said.



THE RESULTS SPEAK FOR THEMSELVES



\$19 billion SanDisk deal hastens shift away from hard disks

Western Digital's acquisition of SanDisk may not lead to lower prices for consumers, experts warn

WESTERN DIGITAL HAS snapped up SanDisk for \$19 billion (£12 billion), suggesting that even a tech giant can't survive in storage without a bit of flash.

The deal will combine WD's consumer and enterprise products with SanDisk's flash memory, as the industry shifts away from hard disks to solid-state storage in laptops, PCs and data centres.

The storage market has been in a sustained period of consolidation, but the past few weeks have seen even more activity than usual. In addition to the SanDisk takeover, Dell snapped up enterprise storage giant EMC for \$67 billion.

Analysts say the storage firms are being forced to join forces to survive. "While the names of the specific companies are somewhat surprising, the actual acquisition makes sense within the competitive landscape," said Dee Robinson, analyst at IHS iSuppli. "There has been speculation about SanDisk being acquired, but until now, it has just been speculation.

"This deal basically cements the fact that storage is increasingly flash-centric, and in order to compete in storage, a company needs to be a flash player or tied up with one."

Joseph Unsworth, an analyst at Gartner, agrees that there's no future in hard disks alone. "WD needs this to stem the lost HDD business in PCs and data centres," he said.

That doesn't mean that hard drives are on the way out, however. "I think it should be thought of as a combination of two companies with some overlap," said Robinson. "So, in that sense, the technology roadmaps for WD and SanDisk are already pretty clear. The purchase of SanDisk will enable WD to have access to flash and flash technology, so they

can be competitive in the SSD market. While there'll be more flash product offerings, they won't necessarily be replacing HDD technology."

Price fall?

Western Digital said the deal will secure "long-term access to solid-state technology at lower cost". However, don't expect dramatic short-term price cuts: SSD prices have been falling for years. According to DRAmEXchange, the price of a 128GB SSD for OEMs hit a milestone low of \$50 (£32) this year, and the analyst firm is expecting SSDs to overtake HDDs in laptops by 2017. That looks set to continue with this acquisition, but the deal won't immediately accelerate price cuts – not least as it doesn't close until the end of 2016, noted Unsworth.

Although the deal price is massive, it doesn't actually boost or reduce competition – there's still the same number of players in the HDD and flash markets respectively, Robinson pointed out. "This market has seen

“However, don't expect dramatic short-term price cuts: SSD prices have been falling for years”



some significant price erosion in this past year, and this acquisition may provide some stabilisation," she said. "The market will continue to be highly competitive, because they are competing against companies such as Samsung and Intel. The only market where these two companies compete directly with each other is the enterprise SSD market, and with their combined revenue, they'll be the number-one supplier." ●

Hard disk sales

After three years of decline, sales of hard disks actually increased in 2014, according to Coughlin Associates, giving hope that the market had bottomed out. However, sales tanked in the early part of 2015, with Western Digital reporting a fall in unit sales from 55.2 million units in Q1 2014 to 50.1 million units in Q1 2015. It's not hard to see why market leader Western Digital wants to diversify.

Squeaky wheel: how Uber's noisy tactics help keep it on the road

Uber won a High Court challenge in London, but faces more legal hurdles across the globe with concerns about driver safety, regulation and congestion

UBER HAS WON its latest legal battle, but the war for Britain's roads continues. The High Court ruled that Uber's ride-hailing app isn't a taxi meter, in a case brought by Transport for London (TfL) with the backing of London's black-cab drivers.

Calum Murray, head of commercial technology at law firm Kemp Little, said the win helps strengthen Uber's position, in London at least. "What Uber is doing, there's clearly a demand for it," he said. "It's now been found by TfL and the courts not to be in breach of regulation."

■ Squeaky wheel

Uber tends to enter a market whether it meets local regulations or not, sometimes leading to bans in cities such as Paris and Rio de Janeiro. Of course, in some cases – including London – it's eventually found to meet local laws, but the "launch first, ask permission later" approach has benefits, said Murray.

"In the UK, there's a bit of a squeaky wheel approach at times," he said. "I think when an issue becomes highlighted, it gets more regulatory attention quicker. Undoubtedly, some of the actions that have been taken by the taxi drivers in London have prompted [TfL] to go to the High Court more quickly than happened in other cities."

Regulation never moves quickly enough to keep up with technology,



except in matters of national security, he noted – and that's okay. "I think it takes time for a kind of common ground to be found," said Murray.

■ What's next

Uber could still face an appeal from London's taxi drivers. Concerns remain around driver treatment and pay, as well as insurance and safety. London mayor

Boris Johnson wants drivers to prove they know their way around the city, and TfL is considering measures to

introduce a minimum five-minute wait time between ordering a car and its arrival.

Murray suggested congestion could be a future sticking point, with private hire car numbers leaping by 18% over the past 18 months. Boris Johnson claimed they were adding 1,000 a month to a total of 76,000, with London's mayor already calling for a cap.

"That's where I can see Uber having to face a big regulatory challenge," Murray

said. "There's an incredible uplift in these types of vehicles on the road, which is going to have a knock-on effect with environmental issues falling from that and emissions. I think that's going to be a challenge for innovating in that space."

Not every hurdle facing Uber is a legal one, he noted. There's nothing to stop an "aggregator" or "meta-provider" stepping in and bundling Uber's service into an overall mega-transport app, as has happened with booking flights online. "I wonder if the next generation of challenges on a business level for [companies] like Uber are that we now have apps that will combine Gett and Hailo and Uber," Murray said. ●

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Online crime in Britain is on the rise

The Office for National Statistics estimates that 5.1 million cases of online fraud affected 3.8 million people in the last year alone. **Nicole Kobie** reveals the cost of this spree

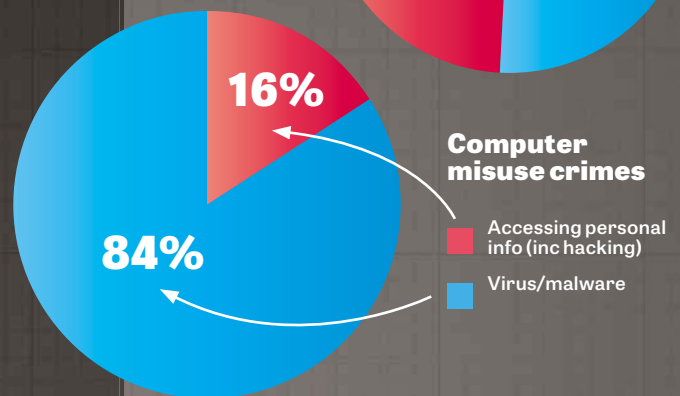
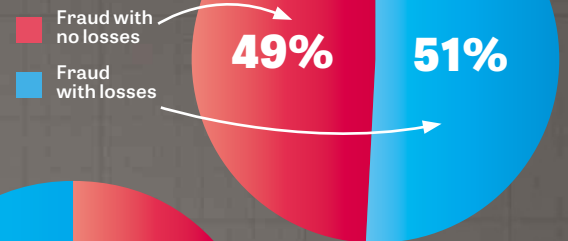
CRIME IS FALLING in Britain – until you include cybercrime. Crime peaked at 19 million offences in 1995, which has, in the past decade, slid to seven million. But as the Office for National Statistics (ONS) noted: “It has been argued that crime has not actually fallen but changed, moving to newer forms of crime not captured by the

survey measurement”.

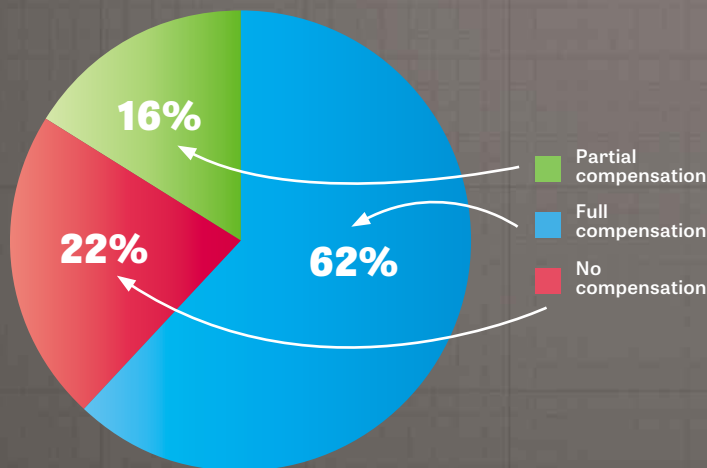
To watch for such a shift, the ONS has begun tracking online fraud and cybercrime, and has estimated that 5.1 million incidents of fraud affected 3.8 million victims over the past year. This is in addition to the 2.5 million crimes that fell under the Computer Misuse Act, such as hacking.



Online fraud losses



How likely are you to get your money back?



The cost of crime

Of the 2.6 million online fraud incidents where victims lost money, only three-quarters were reimbursed by insurance, their payment card provider or

bank. That suggests a fifth of Brits who had money stolen via digital fraud never recoup their losses, according to the ONS – and those losses can be huge.

Indeed, the latest attack to make headlines was the Dridex virus, which harvested online bank details to steal a whopping £20 million from UK victims. The

National Crime Agency's cybercrime department has taken down part of that botnet and made one arrest.

What you're worth to criminals

McAfee has revealed exactly how much crime pays: the average price of a stolen payment card sold online is between £13 to £19. Your stolen financial details are worth more if they include information such as your date of birth, billing address and so on. It's not only payment cards and bank logins that cybercriminals are after: the researchers also spotted a hotel loyalty card with 100,000 points on sale for only £13 and an online auction community account with a high reputation score for £900.

RECEIPT CUSTOMER COPY	
*****	13.00
Payment card (software generated)	16.25
Payment card (with bank ID number)	19.50
Payment card (with DOB)	22.75
Payment card (with full information)	13.00
Online payment account (with £250)	130.00
Online payment account (with £3,200)	455.00
Bank logins (£6,500 balance)	585.00
Bank logins (£10,000 balance)	0.65
Online video streaming account	1255.15
SUB TOTAL	£1255.15
AMOUNT DUE	*****

What is... Solu?

**Fed up with the regular desktop tower and clamshell laptop?
One Finnish startup has developed a radical new design**



What if we were to rebuild computers from the ground up? One Finnish startup has tried, and come up with Solu, a portable pocket computer that stores your files in the cloud and runs an intriguing bespoke OS. Here's how Solu works.

Solu is a cloud-based computer? Someone call Google's lawyers. The idea at the core of Solu has a lot in common with Chromebooks, notably storing files in the cloud for access anywhere, with software that automatically updates and offline support that resyncs files when you reconnect. The small plug-and-play hardware also makes it similar to a thin client: a device that plugs into your monitor and other peripherals, with storage and settings stored over a network.

However, it differs in a few ways. The OS is the developers' own design, with a zoomable mind-map-style file system, and

the hardware can be unplugged and used as a portable device. "When I first started working with the internet, it struck me that it was incredibly dumb that, with the huge resources out there, our machines were limited by their local storage space and their local processing," founder Kristoffer Lawson told *PC Pro*. "We are still there today."

So it's not a full computer? Solu is a pocket computer. It's a 4in square, like a thick wooden coaster with a glass top. The glass acts as a display when it's not plugged into a monitor, and a touchscreen when it is. That means you can access files on the go and use the entire computer as a mini-tablet or handheld gaming device.

What is the OS? It runs the Solu OS, which reorganises how files are found and used. Using a mind-map-style UI, you "zoom" into

rather than clicking through folders. "I still meet people who get confused by the difference between running applications and files," said Lawson. "We removed that difference. In Solu, they are one and the same. You simply zoom in on the content you want to view or use, and you no longer need to open applications. That also means that when you share, you are sharing both the content and the application or tool needed to use that content."

“ You can access files on the go and use the entire computer as a mini-tablet or handheld gaming device ”

Despite the bespoke OS, Solu also runs Android apps and even Microsoft software – Lawson said Word ran on a Solu at the launch event. There's also a basic set of apps

included, though the developers have warned there might be limited support for printers and other devices when the Solu is first released.

What are the specs? The Solu features a 1,440 x 1,440 touchscreen display, but also supports 4K monitors. Inside, there's a 2.3GHz ARM Cortex-A15 CPU plus Nvidia Kepler GPU, as well as 4GB of RAM and 32GB of built-in storage. It connects over dual-band Wi-Fi, Bluetooth 4 or USB Type-C, and boasts a 1,200mAh battery.

How much will Solu cost?

The hardware starts from €349 (£253), which includes three months of the subscription fee. The software and online storage will cost €20 (£14) per month after that – more than twice the cost of an Office 365 Personal subscription.



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PC Probe

Buggy software can now be refunded – here's how

Adam Banks reveals what new consumer-protection laws mean for anyone buying software, apps and digital downloads, and how they will affect developers



Not happy with software you've bought? Go and get your money back.

From October, the Sale of Goods Act was replaced by the Consumer Rights Act 2015. While similar, it extends equivalent protections to digital content for the first time. That means you can take software back if it doesn't work. And it's not just about apps: the Act also covers in-app purchases, subscriptions, music and movie downloads, streaming services and more. Whether you're buying or selling, you need to be aware of the changes.

We consulted two lawyers – Emily Featherstone, associate at Kemp Little LLP, and Steve Kunczewicz, head of IP and media at Bermans – to help us interpret the new legislation. Any errors are not theirs, and this article is not legal advice. A number of uncertainties remain, and may only be resolved when issues turn up in court.

■ Satisfaction guaranteed

Consumer rights are rooted in contract law. When you buy something, a contract is formed between you and the seller. The Act says that inherently includes certain terms, including an understanding that the quality of the goods is "satisfactory".



The lawyers thought this was the element that would have the greatest impact, considering that software licences traditionally disclaim all warranties. That didn't mean users previously had no rights when software turned out to be faulty, but the Consumer Rights Act makes clear that it shouldn't be. "Satisfactory quality" means whatever a "reasonable person" would expect.

That means products must match the sales description, be "durable" (for example, the lifetime of the digital content must meet expectations), and not feature even "minor defects". It's this last provision that may alarm developers. The official explanatory notes to the Act (pcpro.link/255actnotes) acknowledge that "it is the norm to encounter some bugs in a complex game or piece of software on release", but suggest that, at some time after release, users might reasonably expect those bugs to be fixed.

Another concept carried over from the Sale of Goods Act is "fitness for purpose". Originally, this referred only to purposes that the customer specified in advance. Reflecting the fact that users don't generally get to explain what they want from a download before clicking "Buy Now", the Act says digital content must be fit for "all the purposes for which digital content of that kind is usually supplied".

■ On good terms

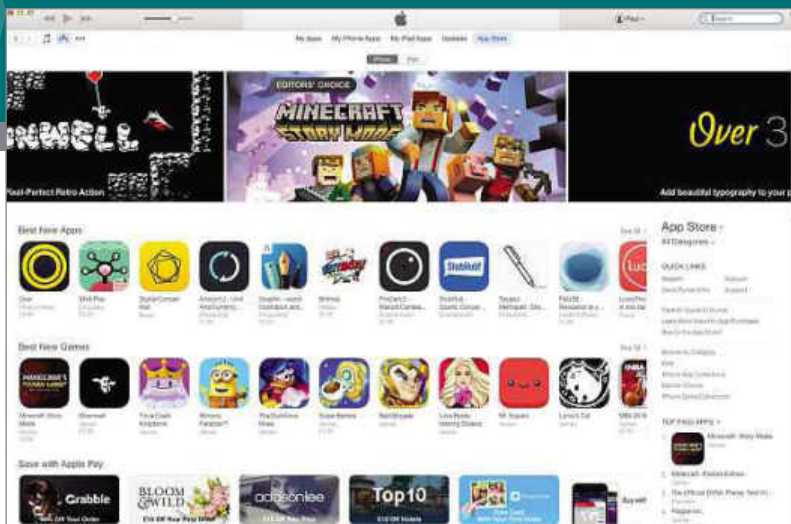
One get-out clause the Act does offer is that the consumer can't claim something is unsatisfactory if it was pointed out to them in the first place. If your product isn't designed to work as people might expect, you can say so upfront.

"Upfront" is a key point. Part two of the Act replaces the

What about businesses?

The new laws cover consumer rights and don't apply to business-to-business transactions. But what about a sole trader buying a PC for both work and personal use? A freelance-friendly

proposal to include "microbusinesses" in the definition of "consumer" was rejected, but the onus falls on the retailer to prove you weren't buying as a consumer.



old “unfair terms” legislation. It says that terms and conditions are only binding if they’re fair, and written in “plain and intelligible language”. That means not hidden in screeds of microscopic legalese.

We can’t help noticing that Apple’s App Store terms and conditions still consist of a lengthy document that begins by announcing that, beyond providing the service with “reasonable care and skill”, it “does not warrant that... your use of the Service will be uninterrupted or error-free”. It’s possible that such terms might be challenged as unfair. An Apple spokesperson wouldn’t comment on whether the company plans to change its terms and conditions. Other vendors have similar clauses.

Game of consequences

If digital content damages other content or your device, the trader (whoever that may be) is liable. That provides new peace of mind for the consumer and, potentially, a new headache for the developer. The trader’s obligation is not to magically guarantee flawless operation, but to exercise “reasonable care and skill”.

According to *Which?*, this means that “there will be a stronger onus on app stores to vet apps properly”. If so, developers might face even longer waits for approval and more arbitrary rejections. But operating systems increasingly sandbox apps to limit any damage they can

ABOVE Updated apps that remove features may no longer be fit for purpose under the new rules

do. There’s now more incentive for operating systems to move in this direction.

Updates must also meet the requirements of quality and fairness. That could give users a claim if features are removed by an automatic update to an app, meaning it’s no longer fit for its original purpose.

Putting it right

If you’re not satisfied with your digital content, you don’t automatically have the right to reject it and seek a refund, as with physical goods. The trader can offer a repair or replacement. In reality, it’s hard to see how that will be feasible, except in simple cases such as a download not being successfully received. Whatever the remedy, it must be delivered in a “reasonable time”, unless there are specific reasons why it’s difficult for the trader.

Our lawyers noted that traders were updating Ts&Cs as they became aware of the Act, and that they may need to change their development cycles and strategy to ensure compliance. Even pricing might need a rethink. The Act notes: “the reasonable expectations of quality for a 69p app would not be as high as for one worth £5.99”. So, if you’re not sure about your app, it may be safer to price it down. ●

Free ride

The Consumer Rights Act is concerned with software purchases – free apps aren’t covered. But if you have to buy something to get the freebie, it’s within scope. Interestingly, there’s a provision to extend this principle to the exchange of personal data for services. For now, it only applies to monetary payment.

We wondered if this would cover any free apps in the iOS App Store, because

you have to buy Apple hardware before you can use them. Our lawyers thought this was unlikely. However, apps that come preinstalled on, or are offered as “free with”, a device are covered, and if they’re not satisfactory, this triggers the right to reject the physical goods.



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comparisons with competitive
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The A-List

The ultimate guide to the very best products on the market today

LAPTOPS

Apple MacBook Pro 13in with Retina display

2015 model, from £999

apple.com/uk

With its innovative Force Touch trackpad, Broadwell processors and the same excellent Retina screen, the MacBook Pro is better than ever. It's fast, with superior battery life to the previous generation, and that trackpad improves all-round usability.

REVIEW: pcpro.link/almacp15



ALTERNATIVES

Asus Zenbook UX303LA

The latest Broadwell Core i7 and a quality screen make this Ultrabook both desirable and great value.

£734; handtec.co.uk

REVIEW: pcpro.link/alzb303

Toshiba Chromebook 2

A good-looking laptop that only weighs 1.35kg and includes an IPS HD screen – this is a tempting non-Windows option. £240; amazon.co.uk **REVIEW:** pcpro.link/altosh2

HP Stream 11

Good-looking, well built and equipped with a decent display, the petite Stream 11 is as good as it gets for the money. £179; hp.co.uk **REVIEW:** pcpro.link/alhp11

TABLETS

Apple iPad Air 2

9.7in tablet, 64GB, £479

apple.com/uk

Even faster, even lighter and just as pretty as ever – the iPad Air 2 takes everything that made the original great and improves upon it. Updated cameras and the arrival of Touch ID are welcome upgrades. Its only real rival is the original 32GB iPad Air, now discounted to a tempting £359.

REVIEW: pcpro.link/alipair



ALTERNATIVES

Samsung Galaxy Tab S2

Fast, slim and with a gorgeous 8in display, the Galaxy Tab S2 is as good as compact tablets get.

£360; handtec.co.uk

REVIEW: pcpro.link/alsgts2

Linx 8

Part of a new wave of ultra-affordable compact Windows tablets, the Linx 8 squeezes in plenty for the price. £100; currys.co.uk **REVIEW:** pcpro.link/allinx8

Apple iPad mini 2

A price drop due to the iPad mini 4's arrival makes this old-timer more attractive than ever. 16GB, £219; apple.com/uk **REVIEW:** see p82

SMARTPHONES

Samsung Galaxy S6

Android, 32GB, free phone, £26/mth, 24mths

uswitch.com

With the Galaxy S6, Samsung has finally created a phone as beautiful as it is capable. Superb performance, a nigh on perfect display and an astonishingly good camera provide the perfect foil to the most attractive Samsung handset yet.

REVIEW: pcpro.link/algals6



ALTERNATIVES

Google Nexus 5X

NEW ENTRY

An ugly duckling but brilliant where it matters: speed, camera, and the latest Android 6 action. £339; store.google.com **REVIEW:** see p62

Sony Xperia Z5 Compact

NEW ENTRY

If you can cope with a "mere" 4.6in screen, this speedy, slender phone has it all. From free, £25/mth, 24mths; uswitch.com **REVIEW:** pcpro.link/alsonyZ5

Apple iPhone 6s

Enthusiasts should upgrade for 3D Touch alone, with extra speed and durability as a bonus. 64GB, from £75, £39/mth, 24mths; uswitch.com **REVIEW:** pcpro.link/alapple6s

PCs

Yoyotech Warbird RS10

Base unit, £600

yoyotech.co.uk **NEW ENTRY**

This PC offers serious power, thanks to an Intel Skylake Core i5 processor overclocked to 4.4GHz, 8GB of DDR4 RAM and a GTX 960 graphics card. Despite this speed, it's quiet in use. An extra £100 will buy a 22in monitor and Zalman mouse/keyboard combo.

REVIEW: see p64



ALTERNATIVES

Apple iMac 21.5in

A classy all-in-one with a compact frame, ample power and a colour-accurate screen. From £899; apple.com/uk **REVIEW:** pcpro.link/alimac215

Apple iMac 27in with Retina 5K display

NEW ENTRY

A new and revamped specification further improves Apple's stunning all-in-one. From £1,599; apple.com/ **REVIEW:** see p56

Acer Revo One RL85

An elegant, versatile compact PC with great expansion options and a competitive price. From £170; ebuyer.com **REVIEW:** pcpro.link/alacervevo

MONITORS

Asus PB287Q

Premium monitor, £380
ebuyer.com

Not so long ago, a 4K display for less than £500 was unimaginable. Asus delivers exactly that: a razor-sharp image on a 28in panel at a very reasonable price.
REVIEW: pcpro.link/alpb287q



Eizo ColorEdge CS240

Eizo ticks almost every box with the 24.1in, 1,920 x 1,200 ColorEdge CS240. With a highly colour-accurate IPS screen, it's the first truly professional-class monitor we've seen at anywhere near this price.
£462; wexphotographic.com
REVIEW: pcpro.link/alcs240

AOC Q2770Pqu

A feature-packed, 27in 2,560 x 1,440 display offering a huge workspace, an adjustable stand, a four-port USB hub and a three-year warranty. Super PLS technology gives great viewing angles too. At this price, it's a steal. **£310; dabs.com**
REVIEW: pcpro.link/alq2770

PRINTERS

Canon Pixma MG6450

All-in-one inkjet printer, £113
printerbase.co.uk

The MG6450 inherits its predecessor's status as PC Pro's favourite inkjet all-in-one, offering high-quality output at a very reasonable price.
REVIEW: pcpro.link/almg6450



Canon Pixma iP8750

Canon's mid-range inkjet is ideal for anyone with a fancy for prints larger than the usual A4. It can print photos at up to A3+ in size, and its six-ink cartridges produce immaculate photographs, yet the price isn't extortionate. **£200; currys.co.uk**
REVIEW: pcpro.link/alip8750

Epson Expression Photo XP-950

Epson's high-end inkjet all-in-one is a fantastic all-rounder for the enthusiast photographer. It combines high-quality prints with a decent scanner, a great touch interface and the ability to output photos at up to A3 in size. **£240; parkcameras.com**
REVIEW: pcpro.link/alxp950

ROUTERS

Netgear R7500 Nighthawk X4

AC2350 router, £190
currys.co.uk

Top Wi-Fi performance close-up and at long range, swift USB NAS performance and all the latest Wi-Fi goodies make the Nighthawk our Wi-Fi router of choice.
REVIEW: pcpro.link/alr7500



D-Link DIR-868L

This 802.11ac wireless router may not have the most impressive set of features, and it lacks an internal modem. However, in our tests it outpaced models costing twice as much, making it an affordable way to get speedy wireless performance. **£103; pcworld.co.uk**
REVIEW: pcpro.link/aldir868l

Netgear Nighthawk AC1900 Extender

The most powerful wireless extender on the market, Netgear's Nighthawk marries five Gigabit networking ports with fast, dual-band 802.11ac support and a host of features. **£125; currys.co.uk**
REVIEW: pcpro.link/alngex7000

HOME NETWORKING

Synology DiskStation DS215+

Network-attached storage, £257
amazon.co.uk

A versatile dual-bay NAS with great support for cloud services, dual USB 3 ports and our favourite web-based management interface. It's speedy and packs a lot into a compact unit.
REVIEW: pcpro.link/alds215plus



Qnap TS-453mini

Superb performance and a decent range of media and server features – including an HDMI output – make this four-bay NAS drive a great choice for both home and business. **£418; dabs.com**
REVIEW: pcpro.link/alts453mini

Google Chromecast

This is the future of TV streaming – cheap to buy and simple to use. Plug the Chromecast into a spare HDMI port at the back of your TV, then browse on your smartphone or tablet and beam Full HD content directly to the big screen. **£30; play.google.com**
REVIEW: pcpro.link/alccast

WEARABLES

LG Watch Urbane

Smartwatch, £159
simplyelectronics.net

The best Android smartwatch out there, with a stylish design – including a proper leather strap – a bright circular OLED screen and 60-hour battery life. It's a great all-round package.
REVIEW: pcpro.link/allgwatch



Apple Watch Sport

The slickest smartwatch experience there is, thanks partly to the unique scroll-wheel interface and advanced haptic features. The weakness is battery life – expect to charge it every night – and even the low-end Sport model is a pricey proposition. **£299, apple.com/uk**
REVIEW: pcpro.link/alapplew

Pebble Time

A fun, practical watch that works with both Android and iOS. App support is comparatively limited, but all the fundamentals are covered, and the colour e-paper screen helps the Time achieve five days of battery life. **£180, firebox.com**
REVIEW: pcpro.link/alpebble

SECURITY SOFTWARE

Kaspersky Internet Security 2015

Another year, another excellent performance for this super-secure, lightweight and unintrusive security suite.

3 PCs/1yr, £35; store.pcpro.co.uk

REVIEW: pcpro.link/alkasis15



Avast Free Antivirus

Still the best free antivirus, although others are catching up. It offers dependable protection – and it doesn't nag you about upgrading. **Free;**

avast.com

REVIEW: pcpro.link/alavast15

Norton Security 2015

A venerable name in security, Norton provides excellent protection and covers up to five devices, including laptops, tablets and smartphones.

5 devices/1yr, £27; amazon.co.uk

REVIEW: pcpro.link/alnort15

PRODUCTIVITY SOFTWARE

Microsoft Office 2016

We'll be honest: there's very little here for anyone upgrading from Office 2013. However, this is still the best office suite for professional.

From £120; office.microsoft.com

REVIEW: pcpro.link/aloffice16



LibreOffice 5

The interface looks a little dated, and the lack of collaboration features is a shame. But interoperability with Word and Excel is better than ever, making this a fine upgrade.

Free, libreoffice.org

REVIEW: pcpro.link/allibre

Scrivener

A brilliant package for serious writers: not only a word processor, but a tool that helps you organise your ideas and manage the process of composition from start to finish. **£29; literatureandlatte.com**

REVIEW: pcpro.link/alscrivener

CREATIVITY SOFTWARE

Adobe Creative Cloud

The licensing model won't suit everyone, but Adobe's suite of creative tools keeps getting better, covering everything from photo and video editing to web development.

Complete plan, £46/mth; adobe.com

REVIEW: pcpro.link/alcc15



Adobe Photoshop Elements 14

Despite few new features, this is still the best home image-editing tool around. Consider subscribing to Lightroom and Photoshop proper instead, though. **£79; amazon.co.uk**

REVIEW: [see 66](http://pcpro.link/see66)

Steinberg Cubase Pro 8

A big bump in performance and a handful of UI improvements keep Cubase at the top of the audio-production tree. A worthwhile upgrade.

£337; dv247.com

REVIEW: pcpro.link/alcubasepro8

SERVERS

HP ProLiant DL80 Gen9

Massive storage capacity combines with a high-speed Xeon E5-2600 v3 CPU and a scalable design to push this HP rack server to the top of the tree. The price is very reasonable as well. **£993**

exc VAT; insight.com **REVIEW:** pcpro.link/alhpd180



HP ProLiant ML150 Gen9

HP's compact tower server packs in a huge range of high-end features, alongside impressive expansion capabilities so it can grow as your business does. A great buy. **£914 exc VAT; insight.com**

REVIEW: pcpro.link/alhplml150

STORAGE APPLIANCES

Qnap TVS-EC1280U-SAS-RP

NEW ENTRY

Hungry for storage? Then take note of this 12-bay 2U NAS, to which you can connect up to eight disk shelves for a total of 140 drives. A 3.5GHz Xeon CPU speeds things along. **Diskless, £3,556 exc VAT; lambda-tek.com**

REVIEW: [see p94](http://pcpro.link/see94)



Synology RackStation RS2416RP+

NEW ENTRY

Built with speed and expansion in mind, this 2U rack NAS offers a feast of storage features and plenty of expansion potential. It's good value, too. **Diskless, £1,399 exc VAT; lambda-tek.com**

REVIEW: [see p96](http://pcpro.link/see96)

SECURITY

Sophos SG 115w

A security appliance that gets it right on almost every level. Easy deployment, a huge range of features and a tempting price make this the perfect choice for SMBs. **With 1yr FullGuard, £809 exc VAT; sophos.com**

REVIEW: pcpro.link/alsophoss9



Sophos Cloud

User-based policies and slick mobile support make this a top-class cloud solution. Performance is impressive, too. It's not the cheapest option, but it's a pleasure to use. **10 users, £510/yr exc VAT; sophos.com**

REVIEW: pcpro.link/alscloud

BUSINESS PRINTERS

Epson WorkForce Pro WF-5620DWF

Shatters the myth that inkjets are only for low-demand use, delivering fast output speeds, low running costs and tons of features.

It prints at 20 pages per minute, and quality is perfectly acceptable – it can even print glossy photos. **£187 exc VAT; printerland.co.uk**

REVIEW: pcpro.link/alwf5620

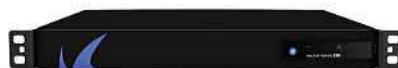


BACKUP

Barracuda Backup Server 290

A beautifully simple appliance that brings together on-site and cloud backup. There's block-level deduplication, extensive support for Windows systems and applications, integral Exchange MLB, and simple deployment and management. **£4,446 exc VAT; barracuda.com**

REVIEW: pcpro.link/alserver290



DataFort Critical Care

DataFort's managed backup service takes care of everything, even bringing up virtual clones of your systems should disaster strike. Per-server pricing makes it cost-effective too. **One server, £350/mth exc VAT; datafort.com**

REVIEW: pcpro.link/aldatafort

NETWORK MANAGEMENT

Paessler PRTG Network Monitor 15

A network-management solution that's ideal for businesses on a tight budget. Supports a wide range of devices, which are included in the price, and licensing is based purely on sensor count, so there are no hidden costs. An excellent way to keep tabs on what's going on in your network.

500 sensors, 1yr, £1,036 exc VAT; paessler.com

REVIEW: pcpro.link/alprt915



SolarWinds Orion NPM 11.5

Offers excellent value for money, packing in a huge number of monitoring features as standard, including support for 802.11 wireless access points and virtual machines. **250 elements, £4,110 exc VAT; solarwinds.com**

REVIEW: pcpro.link/alnpm115

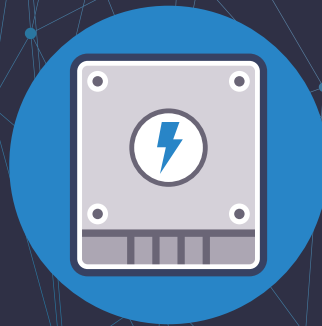


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Profile

BACKGROUND INFO ON INNOVATIVE BRITISH COMPANIES

AAISP

We meet the refreshingly honest ISP that doesn't shy away from talking straight with customers, partners or the government



All of AAISP's support staff are well trained and don't work from pre-prepared scripts

KEY FACTS

IN A NUTSHELL

AAISP is a UK ISP that aims to "provide top-quality and leading-edge telecommunications solutions for technical and professional customers".

LOCATION

Bracknell, Berkshire

FOUNDED

1997

STAFF

20

WEBSITE

aaisp.net

There's a certain ISP that likes to portray itself as the "straight-talking" broadband provider from Yorkshire, but when it comes to telling it as it is, Bracknell-based AAISP makes its rival look like a mealy-mouthed politician.

"We have a policy of no bulls**t and will not fob you off with a convenient but unhelpful answer," reads its startlingly frank website. "In return, we do expect our customers to be honest with us, and to pay their bills on time." The company's homepage carries a banner urging customers to "say no to the #snooperscharter". Even the automated email that bounced back from the company's press inbox carries an amusingly blunt warning: "Please note, as per our web pages (where this email address is published) any marketing emails sent to this address will be invoiced for a spell-checking service at £50+VAT."

AAISP is not your typical broadband provider, and its managing director Adrian Kennard is not your typical corporate mouthpiece either. During the course of our conversation he brands the Prime Minister "crazy", reveals why he refuses to use the term "fibre broadband" to describe "copper-based" fibre-to-the-cabinet, and cuts off in the middle of the conversation to give his builders a rollicking. This is a man, and indeed a company, that doesn't give fools the time of day.

The techie's choice?

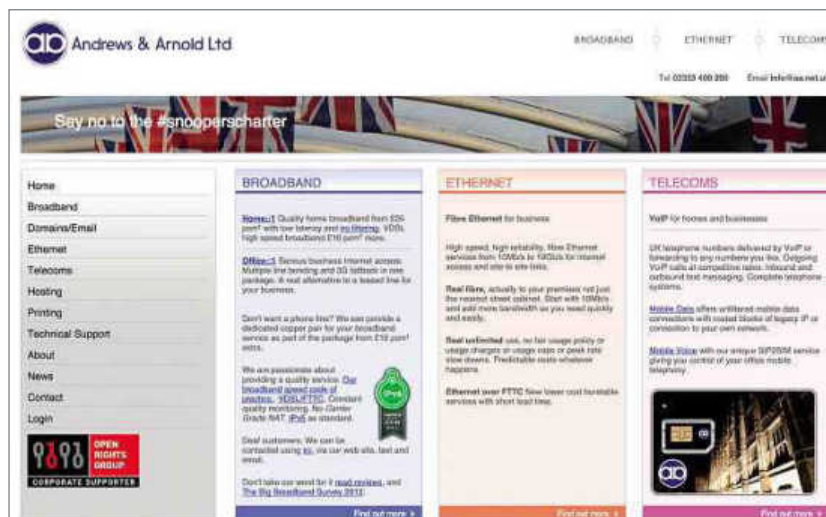
AAISP's website could barely be more different from the glossy, corporate facades of the "big six" broadband providers. There's no B-list celebrity video ads, no "free" broadband offers. You might even say the website looks a little dated. But AAISP isn't out to attract the casual punter who wants the cheapest possible broadband. Instead, it's targeting the technically minded consumer and small business that doesn't want their connection throttled, filtered or monitored, who's perfectly happy installing their own router, and who wants a block of IPv6 addresses thrown in. It's targeting the kind of customer who, dare we say it, might read *PC Pro*.

"We try and do things right in everything we're doing, whether it's technical, ethical or whatever," said Kennard. "The technical side of that means our customers are able to make proper use of the internet. They can have things such as reverse DNS on their IP addresses, they can have things such as blocks of IPv6 addresses. If someone just wants a cheap internet connection to check their email and go to Facebook, we're probably not the most obvious choice. We're not really trying to entice people on price. It's more about the quality and technical capabilities of what we're doing."

Kennard says the technically competent customers will

notice the difference if they ever have to make a call to the company's support team. "All of our technical support staff are well trained and know what they're talking about," said Kennard. "They're not following some script, they're not just employed to answer the phone. We try not to treat people like idiots and insist upon going through every silly step on a script. A lot of our customers know exactly what they're doing. If they phone up and say 'I've tried it with two different routers and it's still not working', we don't start by saying 'have you got a Start button in Windows?'"

Kennard admits finding suitably trained staff to man the



RIGHT AAISP's technically minded homepage couldn't be more different from the glossy sites of the major providers



ABOVE All of the broadband lines are monitored in great detail every second

RIGHT AAISP's customisable mobile data SIMs provide a fixed IPv4 address

company's support lines is something of a challenge, but the company has spent the past 15 years developing tools to help its team diagnose problems on customers' connections. "We have vigorously detailed monitoring of broadband lines – we monitor every line, every second," said Kennard. "That gives us some really good advantages when we're identifying faults on lines. It also lets us correlate if a problem is at the exchange, or a metro node, or some part of BT or TalkTalk backhaul, and actually report those problems even before the customer has reported the problem to us, and get the carriers to fix their networks."

Kennard says the support staff are recruited from other ISPs or trained from scratch, and part of that training involves working with network providers such as BT to send staff into the telephone exchanges where the physical connections reside. "Every six months or year, we'll get new staff on an exchange tour so they can actually see what happens in an exchange – where the wires go, what jumpering is, what the test head is, what a DSLAM is, how it all goes together – so they understand this when they're talking with a customer and with BT."

■ Dealing with the big boys and Big Brother

However, Kennard admits the company's relationship with BT doesn't run entirely smoothly. In fact, one member of his 20-strong staff is now devoted entirely to dealing with disputes with the wholesale providers, BT and TalkTalk. AAISP buys broadband connections from both companies, but Kennard claims both "try and pretend" that they're selling AAISP a line rather than an actual broadband connection, and when a broadband develops they make AAISP pay for the engineer visits. "That's always a challenge and there's always a large amount of disputed bills because of it," he said. "At

the moment, what works is not paying these bills and threatening to sue them if they don't pay them. But it does mean we've got a guy who spends at least half his time dealing with billing disputes. It's crazy we have to employ someone to do this."

And, unlike the big boys, who have close links to government (TalkTalk chief executive Dido Harding is married to a Conservative MP; BT had former cabinet minister Patricia Hewitt on its board until 2014 and its former CEO Ian Livingston is a Conservative peer), Kennard isn't afraid to poke a stick at the establishment.

This isn't limited to the aforementioned homepage carrying an anti-surveillance banner: the company is also part-funding a project, with the Open Rights Group, which highlights when "legitimate" sites are blocked by the big ISPs' content filters. Kennard once even had his own blog (revk.uk) added to TalkTalk's blacklists. AAISP is currently small enough to fly under the government's radar, with no legal requirement to offer any filtering on its network, and Kennard is very keen that it remains that way.

"It's technically a pain in the arse," he said. "It's morally questionable and most filtering is ineffective. You can just go to a VPN or through a proxy, or lots of other ways

to bypass filters. The Pirate Bay filtering,

which applies filters to one website, is totally ineffective. Yet the government is trying to filter a legal and well-funded industry like porn, which is crazy. It has more negative side effects of trying to put this technology in place than it does benefits," he said, adding: "A lot of us think there are ulterior motives. They're already talking about extending it [filtering] to cover extremist websites. How long before extremist just means the wrong political party?"

Equally "crazy", according to Kennard, are David Cameron's attempts to subvert encryption, against which the company is also protesting. In fact, Kennard has little faith in the technical ability of the government and security forces, and makes a point of highlighting that on the rare occasions his company is forced to hand over details of its customers to the police. "If ever they ask for the 'user details', we say 'sorry, we haven't got the means of knowing who the user is'," he said. "If they ask for the subscriber, we stress this doesn't necessarily have to be the user or even someone in the premises. They could be running a TOR exit node, they could be running a VPN, they could have a virus. This is in no way an indication of who the user is."

Is Kennard worried that by taking such a libertarian (some might say awkward) stance, his ISP could become a magnet for those up to no good? "If someone was into something dodgy, whether it was paedophiles, terrorists or whatever, there is no reason for those people to come to us," he argued. "They can just use TOR or other encryption services, over any ISP, and access whatever they need. There's no reason for them to come to us because the filtering and monitoring of other ISPs is completely ineffective."

And with that, the straightest-talking broadband provider we've come across was off to continue giving the government a hard time. And his builders. **BARRY COLLINS**



“If the police ever ask for the ‘user details’, we say ‘sorry, we haven’t got the means of knowing who the user is’”

What about you?

Do you work for a British technology company that could be profiled in *PC Pro*? If so, get in touch: profile@pcpro.co.uk

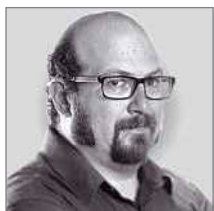


Viewpoints

PC Pro readers and experts give their views on the world of technology

Wireless charging is a great idea, but far from ready

The concept of wireless charging sounds futuristic, but the reality is profoundly disappointing



Darien Graham-Smith is PC Pro's deputy editor. He prefers to measure out his everyday life using milliamp-hours.

I was genuinely excited this month to get my hands on a new phone – a Samsung Galaxy S6, to be precise – with wireless charging. So excited, in fact, that I set aside my normal rule about only buying phones with replaceable batteries.

Previously, I would consider a non-removable battery a deal-breaker. I know, not everyone cares about fitting an extended battery, though I have to say I don't understand why: I'll take a chunky handset that goes the distance over a super-slim model that dies on the Tube home any day. But even if you plan to stick with the regular battery, it's a fact of life that lithium-ion cells degrade with use. Your shiny new smartphone might get you through the day, but will it still after 18 months of daily recharging? You'd better hope so, because replacing its ailing battery with a new one is not something most of us want to try at home.

Unfortunately, removable batteries have fallen out of fashion. As usual, I blame Apple for perpetuating the idea of consumer electronics as sealed boxes whose innards

shouldn't be dabbled with. But perhaps – I told myself as I scoped out options for my biennial upgrade – it's not such a big deal any more. With the advent of wireless charging, topping up the battery would be so effortless that it simply wouldn't matter if it needed to be done two or three times a day.

This was, of course, a naive expectation. I should have learnt my lesson from 3D printing, which sparked all sorts of exciting ideas in my imagination until I tried it out for myself and discovered just how slow, scrappy and unreliable most affordable desktop printers really are.

In the same way, the concept of wireless charging sounds excitingly futuristic, but the reality is profoundly disappointing. When you think about wireless technology, you probably imagine Wi-Fi, or perhaps Bluetooth, which let your phone and laptop stay connected while they're in your bag, or sitting in the next room. A similarly easy arrangement for power transmission would be revolutionary: you could charge up your phone by simply sitting down in the general area of a charger. Put one next to your sofa, and another by your desk at work, and you could forget about day-to-day charging.

Unfortunately, this is where physics steps in to spoil the fun. The strength of a Wi-Fi

“I blame Apple for perpetuating the idea of consumer electronics as sealed boxes whose innards shouldn't be dabbled with”

signal drops off very quickly as you move away from the router, but that's fine as long as you can still distinguish the ones from the zeroes at a reasonable distance. With inductive resonance charging, the strength of the magnetic field is everything, which means a regular-sized phone has to be positioned within a few inches of a wireless charger to draw any useful amount of power from it. Thus, instead of wireless charging zones, we have to make do with compact pads – the official charging podium for the Galaxy S6 has a diameter of around four inches – onto which you deliberately place your handset to charge it up.

Is this actually any better than charging with a cable? I suppose there are fewer wires strewn around the place, which, in my household at least, is a step forward. But far from untethering our phones from

their chargers, the pad restricts us more: with a longish cable, you can happily play games, send messages and even make and receive calls while the phone's charging. Try the same with a phone that's rooted to a four-inch charging pad and you're likely to get neck ache.

A larger charger isn't the answer, either. At first, I assumed that the 4in pad was simply a convenient size to manufacture and ship. Indeed, Ikea sells entire tables with chargers built into their tops, which sounds like it would let you plonk your phone down anywhere to charge. Not a bit of it: because of the way magnetic resonance works, a tabletop-sized loop won't charge a small one, as found in your smartphone. Your Ikea Nordli table actually comes with a single four-inch Morik charger embedded into its flat surface. Accidentally knock your phone away from the hotspot and there's no charge for you. Oh, and don't forget – wireless charging is around 50% slower than using a regular 2A charger.

Fortunately, some very clever people are working on ways to improve matters. Last year, researchers at Duke University in the US managed to extend the range of an inductive resonance charger using exciting-sounding “metamaterials”, which have electromagnetic properties not found in nature. More recently, a team from the Korea Advanced Institute of Science and Technology created a multi-coil system capable of sending wireless power over a distance of 5m – although, since their apparatus used 3m ferrite rods, it might not be suitable for smartphones unless they're of

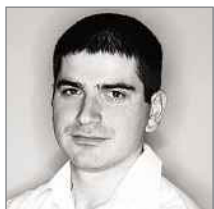
Trigger Happy TV proportions. For those applications requiring much longer ranges, some impressive results have been achieved by firing infrared lasers directly at solar cells. That said, here the challenge is focusing the beam in the right place.

Whichever technology finally makes it into our portable devices, it's clearly going to take a few years to arrive. And, in the meantime, the happy idea that our phones might quietly recharge themselves during the day, as we go about our business, will clearly remain a fantasy. So my plea to mobile manufacturers is simple: don't give up on the removable batteries just yet. My new phone certainly looks sleek and stylish sitting on its pad, but from time to time – call me mad – I just want to pick it up and use it.

darien@pcpro.co.uk

What's going on beneath the Surface of Microsoft?

The tech giant's first laptop shows the Windows monopoly still allows it to do what it wants



Barry Collins is a former editor of PC Pro. He's still got an original Surface Pro, which deserved to run up a billion-dollar debt.

Microsoft has now released the Surface Book – a laptop version of the Surface, which Microsoft bills as “the tablet that can replace your laptop”. Confused? Not as confused as the PC makers will be.

When Microsoft first began building Surface tablets, it arrogantly claimed

that it was setting an example for the OEMs. Nobody else was building high-end tablet hardware that was good enough to compete with Apple, so Microsoft had been forced to do so itself. “Our OEMs do great work, but there are places their brands and investments don’t travel,” Steve Ballmer said in a 2013 interview. “And so we wanted to supplement the work of our OEMs, hopefully make our OEMs stronger through the process, by making our overall competition with Apple.”

Some competition. Microsoft wrote off almost a billion dollars in 2013 to account for the piles of unsold Surface tablets that lay in warehouses, and while the tablet’s fortunes have improved markedly since the release of the much-improved third-generation hardware, Surface sales are paltry compared to those of Apple’s iPad and MacBook range. Microsoft’s latest set of quarterly results put the Surface revenue at \$888 million; Apple’s most recent earnings showed iPad revenue at \$4.5 billion and Macs at just over \$6 billion.

Yet even if Microsoft could make the case that no other PC manufacturer was making tablet hardware quite like the Surface, it’s on thinner ice when it claims the Surface Book “redefines the laptop”, as its press release proudly announced. Microsoft is far from the first manufacturer to deliver a Windows laptop with a detachable screen. The Asus

Transformer Book series has delivered delightful hybrids for the past couple of years – the Transformer Book T100 earned a five-star review from us earlier this year – and almost all of the major manufacturers have dabbled with the form factor at some point. Microsoft’s Surface Book might have a fancy new hinge and a high-end spec, but it’s hardly unique.

If Microsoft’s trying to claim that no other laptop manufacturer is taking the fight to Apple’s MacBook range, I’d again disagree. Yes, Apple’s MacBook Pro won our premium laptop Labs in the summer, but it was pushed mightily close by devices such as the Dell XPS 13 (which is only a better screen away from perfection) and the overpriced Lenovo ThinkPad X1 Carbon. There’s no shortage of decent high-end Windows laptops.

That doubtless leaves PC manufacturers wondering quite what Microsoft’s up to with the Surface Book. Having vowed not to step on OEMs’ toes when it first launched the Surface, Microsoft has now reversed over their size 10s with a double-decker bus. Nadella may blather that the new range of Surface devices “promise to fuel even more enthusiasm and opportunity for the entire Windows ecosystem,” but nobody’s buying Dell, HP or Asus gear because Microsoft’s knocking out some cracking hardware. Microsoft’s in this for itself.

Of course, Microsoft’s not about to withdraw Windows from third-party OEMs. There are still billions to be made from selling Windows licences on third-party hardware, and there are many PC form factors that Microsoft’s hardware range doesn’t cover, not least the billions of office PCs worldwide.

However, Microsoft is following Apple’s lead in the consumer market. It has dropped the upgrade fees for updated versions of Windows, with Windows 10 now delivering features as and when they arrive. Like Apple, it has a host of apps and services that it can bundle with its own hardware: OneDrive, Office, Skype, even Minecraft. It also has an expanding range of hardware: (flailing) Windows smartphones, Surface tablets and now its own laptop.

Microsoft is marching towards the high ground, hoping that premium hardware profit margins will compensate for the decreasing revenue generated by selling Windows licences. Apple doesn’t make any money per se from OS X, and Microsoft will make no money from Windows on its own hardware. Unlike Apple, though, Microsoft will still have a legion of OEMs licensing Windows for use on their £399 laptops or £150 tablets. Microsoft gets a cut either way.

It’s a clever, calculated risk. Partners such as Dell, HP and Lenovo may be deeply unimpressed that Microsoft has barged into their territory and is potentially stealing some of their more lucrative customers, but what are they going to do about it? Migrate to Ubuntu? Microsoft can afford to compete with its own customers – making a bigger profit, as it doesn’t have to pay for the

operating system – because there’s no credible alternative to Windows.

Nadella can pay lip service to the idea of boosting “the entire Windows ecosystem” by extending the Surface hardware range, but the only company that stands to benefit is Microsoft itself. Provided consumers warm to its hardware. And that, as early Surface tablet sales proved, is the billion-dollar question.

 barry@mediabc.co.uk

Code runs our lives. Someone needs to keep it honest

The Volkswagen scandal shows we need to keep a closer watch on what software is actually doing



Nicole Kobie is PC Pro's Briefing and Futures editor. She doesn't have trust issues, why ask?

Do you trust your software? Whether it’s the code running your PC, your smart home or your car, do you know what it’s programmed to do?

Of course you don’t. The current Volkswagen scandal shows that we can’t inherently trust our smart devices to do as promised. The car

manufacturer has admitted to fiddling with software in its emissions-tracking system. Bring the car into a lab for emissions checks, and it limits the engine and the emissions. Take it back on the road, and the engine runs as normal, spewing illegal levels of pollutants into the atmosphere.

The VW debacle raises an intriguing question that’s especially pertinent as we shift to the Internet of Things (IoT): how do we know that the code that runs our gadgets, our cars, our homes and other aspects of our lives is doing what it’s supposed to?

If you have a standard “dumb” thermostat managing your heating, it’s obvious when it doesn’t work as it should: your house will either be too hot or too cold. With a smart thermostat, such as Google’s Nest, it’s a little more complicated. Through faulty coding, it could leak data online, such as whether your home is occupied; or it could incorrectly turn on in the middle of the day when nobody’s home. Unless you’re particularly vigilant with your energy bill, you may never notice.

Such smart devices are, more often than not, black boxes. We have no access to the code that runs them. How can we keep them honest? Some have suggested we

“Having vowed not to step on OEMs’ toes when it launched the Surface, Microsoft has now run them over with a bus”

could require all software and firmware to be made open-source and thus freely available for inspection, but it's unlikely most companies would willingly hand their "secret sauce" recipe to the open market.

Another solution sees us little people using the IoT to keep watch ourselves. Cheap sensors make it easier to monitor devices and machines, and Raspberry Pi creator Eben Upton pointed out to *Fortune* that the maker movement has the tools and capability to have caught out Volkswagen. "It seems like we've gone through this trough where only 100 people in the world have the tools to test something like the Volkswagen emissions, to having a limitless number of people having the tool to detect this," he told the magazine, saying a \$2 sensor and a bit of scepticism is all that you need.

It's a grand idea, using the Internet of Things to monitor our world, rather than having tech companies and governments watch for us. But checking a car's emissions isn't as simple as waving a cheap sensor at the exhaust. Indeed, as Upton suggested, it may well be interested, expert parties who take up this challenge: environmental charities could team up with the maker movement to gather the data they need to catch dishonest companies.

But, with everything run by code, we can't simply leave it to geeks and activists to hold companies accountable – they must be held legally responsible, and a regulator needs to keep them in line. That's one of the other solutions that's been suggested: a code regulator could comb through software and look for oddities and errors. The "Ministry of Code" wouldn't only allay companies' fears about their intellectual property being open-sourced, it could make code more secure if the regulator was also tasked with keeping an eye out for vulnerabilities, and didn't simply keep those zero-day flaws for the security services.

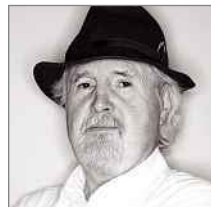
Consider self-driving cars. Volvo's CEO Håkan Samuelsson has said his firm would "accept full liability whenever one of its cars is in autonomous mode". Yes, as it should: it wrote the software that's controlling the car, after all. Software is simply a component, just a more modern part – we'd hold a car maker responsible if faulty brakes caused an accident, so why should code be any different? Auto regulators may well know what to look for when it comes to brakes, but code checking requires a very different skillset. A software regulator could look for dodgy code, rather than let us find out the hard way.

We couldn't trust Volkswagen on emissions software; let's not trust anyone else when it comes to the code controlling our lives. It's time we kept them honest.

 work@nicolekobie.com

Think free is always good? Careful what you wish for

We live in a golden age of information sharing, but the ramifications may not be pretty



Dick Pountain edits the Real World Computing section. To paraphrase St Augustine, "give him free information, but not yet".

This column has respected, but never wholly believed in, the proposition that information wants to be free. My own reservations stem from realism, namely that information now bears costs for creating, storing and distributing it – costs that have to be met somehow. Exactly how they're met is a matter not for technology, but politics (or political economy, to be pedantic).

For example, I believe that all digitised archives of science and out-of-copyright literature should be available online for free, with the costs paid by the taxpayer as part of the education budget. However, I also believe that those who want to write, make music or act for a living should be paid to do so, and that, right now, the market is better at doing that than the state. *PC Pro* exists because you thought it worth paying for, and advertisers thought it worth advertising in, and, hence, I get paid to write this column.

“Information has become both too valuable and too cheap, undermining our economic model based on private property”

We can imagine other ways to get paid for creating new information. In the Soviet Union, the state subsidised many of the arts. More recently, it's become possible to make serious money from YouTube videos, or writing a blog that takes adverts (or, in rare cases, by charging a subscription). What's certainly true is that until food, housing, clothing, transport and bandwidth also become free, it's not going to be possible to perform such information-producing activities full-time without getting paid. However, doing them in their spare time will in many cases – novelists, pianists, film directors – lead to a drastic loss of quality.

Free-marketeers may argue that this is where its model wins, but there's a problem with markets: they don't enjoy competition, and instead aspire to become monopolies. What's more, the massive selling power of our mass media amplifies a tendency towards "winner takes all", whereby a tiny handful of authors, games, bands and movie stars attract almost all of the huge revenues, leaving bare survival for the rest.

A third problem for markets is that many people take the attitude that, not only does information have no desire to be free, it wants to charge rent: enough rent for them to live merely by owning and hoarding it rather than producing it. This tendency for rent-seeking is obvious in film corporations that lobbied for the extension of copyright to 75 years to protect their back-catalogue revenues. Less blatantly, it also lies behind a trend in the software business towards rental rather than just outright sale of programs. Microsoft Office 365, Adobe Creative Cloud and an increasing number of Android apps are choosing this route of monthly or annual subscription only (both of my two favoured Android office suites, OfficeSuite and Polaris Office, have gone this way).

That's where *Postcapitalism* by Paul Mason, the economics editor of Channel 4 News, steps in. He argues that not only does information want to be free, but that it will inexorably cause everything else to become free too. His analysis is plausible, even if it's dense and hard work in places.

One key tenet of his argument is that digital information is a substance without comparison in human history. It can be reproduced for nothing, and this has effects far beyond the digital realm, subverting the mechanism by which prices are set. Profitable markets depend upon inequality of information, and once everyone has the same, instant, price information, margins get squeezed towards zero (see Amazon). Also, digital automation and robotic technologies make it possible to reduce the amount of

human labour needed to produce material goods, threatening to do away with millions of jobs and wages. Information has become both too valuable and too cheap, undermining our whole economic model based on private property.

In one possible future, finance rules, jobless people live on credit and all profit comes from rent and interest rather than from exploiting labour. In another, the state pays everyone a living wage to voluntarily perform self-organised tasks that used to be state services. If that sounds crazy, Mason cites a familiar modern example: "The biggest information product in the world – Wikipedia – is made by 27,000 volunteers, for free. If it were run as a commercial site, Wikipedia's revenue could be \$2.8 billion a year. Yet Wikipedia makes no profit. And, in doing so, it makes it almost impossible for anybody else to make a profit in the same space." So which future roadmap is crazy?

 dick@dickpountain.co.uk

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James Gillen

Web designer

■ What do you do?

I'm a web designer at Torchbox, so day to day I'll be designing websites, and building mock-ups and wireframes in Photoshop and Illustrator. I'll then be in Sublime Text 2 writing CSS and HTML to create responsive prototypes that we can show to clients, instead of just stills.

■ Describe a typical working day.

One of the first things I do every morning is look for inspiration on Dribbble [which describes itself as "show and tell for designers"] or CodePen – where people are doing innovative stuff with CSS – because it's good to keep on top of that stuff.

This morning I had a chat with one of the other designers about how we could make the elements better. After that, I designed some listings, starting off in Illustrator to rough them out, before transferring to the browser and using Sublime Text to code them.

I made sure it was working at all screen widths and looked good. Just before lunch, I sat with the creative director and he gave me some pointers about how we could improve some areas. A lot of the job is going backwards and forwards between other designers, then me going between a flat program [for example, mocking up a site in Photoshop] to get an idea of what I want it to look like before coding it.

The advantage of coding is that, when we pass it over to our front-end developers, they know exactly how we want the interactions and hover states to work. They are just as important as the overall visual look.

■ What is the structure of the team?

There are quite a lot of us at Torchbox: a project manager, who initially speaks to the client, and the designers who come in to discuss how it will look and feel. We'll then start to do some prototypes while working with a front-end developer because there might be certain issues – for instance, I was recently trying to insert an Instagram feed, but it proved difficult so I asked one of our front-end developers to help me.

We always start a project by mood boarding and getting a rough idea of the style we have in mind, before talking to the client about it. We also show them websites that are relevant to the project to see what they think works and how we may take inspiration.

When the design is signed off, the front-end will go in and build it into a content-management system.

■ How did you get into the industry?

I did a foundation degree in interactive design at Bath Spa University, and an internship at Concrete Studios, where I did a lot of testing and a little bit of design.

I then did a BA in graphic design at the University of the West of England. I continued to do freelance work while at university before getting the job here at Torchbox 18 months ago.

■ What part did your qualifications play?

We're currently advertising for a junior designer and, to be honest, we're looking at their work experience first because we have so many



£20k
Approximate
starting salary

56
Permanent jobs
(itjobswatch.
co.uk)

£28k
Average
earnings

applicants. Then, if their portfolio is good, we'll go back and look at their qualifications.

I'm not sure it's that important to have a degree, but I'd say that I became a much better designer at university, which I don't think I would have done if I had just worked. You get to experiment and try things out in an environment where it doesn't really matter, but you can't really do that in the industry because it all costs money.

■ What advice have you got for anyone who wants to pursue your career?

Do as much design work as you can, as it shows you can manage a project and work on your own. Make sure you tailor your portfolio to whatever job you're applying for and design everything – including your CV, portfolio and covering letter – which will go a long way. If you're showing student work, try to see how it would live in a real-world situation, and talk about how the skills you developed during the work you did at university are transferable to client projects.

■ What's the career path?

I started off as a junior designer, which is something a lot of people do immediately after they graduate from university. I was recently promoted to mid-weight designer. After that, the career progression is normally the following: senior designer – we have two at Torchbox – and then, finally, creative director. That's the usual career route, but you can also move into other fields and perhaps try your hand at specialising in user-experience design (UXD), rather than just focusing on visual design. ●

Where to start

■ CodePen (codepen.io) is excellent for CSS experimentation, while Dribbble (dribbble.com) is a resource for design inspiration



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Readers' comments

Your views and feedback from email and the web

Purely theoretically...

I wanted to respond to Tim Danton's musings on how hackers might gain access to a company's data ([pcpro.link/255hackers](#)).

Most hackers have a favourite target – some prefer web servers of a particular flavour, others prefer Remote Desktop or SSH. So, what does this look like in the real world? Here's a practical example.

Let's say my target of choice is the WordPress platform. Now, because I have access to the WordPress source code, I spend all day poring over the code looking for possible weaknesses. If I find one, I can turn to the cross-platform, Python-based Exploit Pack tool to write and test the exploit.

I would then need to find a list of targets that would be affected by my vulnerability. This can be a manual process (search Google for sites running WordPress), but a clever hacker can automate it. The ZMap tool, for example, will quickly scan very large segments of the internet for services running on specific ports, finding all of the web servers on the "regular internet" in a couple of days. It would then be a simple matter of crawling those sites using a tool such as Burp Suite, and looking for "wp-content/themes".

But how do I tie it all together? I take the list of targets found using ZMap and Burp, then export it into Exploit Pack, select my handcrafted vulnerability as my auxiliary payload, and select a payload (which can be any number of things, but, in a case like this, I'd go with a PHP shell as my payload to allow me to do whatever I want on the box) and hit "Go".

A little patience, and now I've got a remote shell on potentially tens of thousands of hosts from which I can do a number of things, including defacing websites, stealing content, stealing credentials, hosting malware and many more. If the site contained anything really juicy, I might be able to sell it, or monetise it in a different way (using the content, for example, as blackmail).

All said and done, the only tool I would need to pay for to achieve all of this would be a commercial copy of Burp Suite, which costs \$300, which I could quickly recover by ransoming the websites I'd just "pwned" ("owned", or taken over). **SodaPhish**

Star letter

After visiting a few aisles in the supermarket recently, I found that somebody had sneaked something extra in my trolley. Fortunately, I noticed before paying. The product was also labelled completely differently to what was in the box. I found the salesperson responsible and told them I didn't want that product. A couple of weeks later, there it was again, without me noticing or being told. Outrageous.

The supermarket in question is Microsoft, and the product I'm talking about is GWX update KB3035583. I'd removed it and hidden it to prevent it reoccurring, but Microsoft ignored my wishes and forced it on me again, dishonestly describing it as an important Windows 7 update. A friend in hospital, with his laptop

tethered to a mobile phone, had his entire 3GB monthly data allowance swallowed up in a single day by this drive-by download, which is bringing the Windows update process into disrepute.

We're generally advised to ensure that automatic updates are switched on but, after many years of trusting Windows Update, I've now switched it off (and set to notify but not install). I now examine updates before installing.

Windows 10 has nothing for me that I can't do already in Windows 7. Worse still, Microsoft says Windows 10 updates can't be refused. Please shout louder about this before IT deceit is accepted as the norm. **Paul Brow**

This month's star letter wins a 120GB Samsung 850 Evo SSD worth £53



ABOVE Even densely populated areas of the countryside struggle with connections

Fibre frustration

I thought your recent article on the spread of broadband was hopelessly biased towards the government and money men. I live in a comparatively densely populated part of East Sussex and, for a couple of years, I have had so called "high-speed fibre" from TalkTalk. I test its speed every day, usually achieving around 17Mbps/sec. That's not high-speed fibre, is it?

The problem is that both the government and money men are simply not interested in providing a proper service to the minority who live in the countryside. Frankly, it's outrageous and that's what you should be saying. Other countries can do it, and as one of the wealthiest countries in the world, we could afford it. However, the government and financial establishment in this country are now only interested in fast profits. **Dudley Dean**

Reboot blues

I sit here on a Saturday morning with a reminder that a "Computer restart is needed for AVG". I've postponed it for several days so far. During the past few weeks, from memory, I've had to reboot my laptop four or five times, usually due to either Windows or AVG updating. The last two Windows updates have been time-consuming, and I watched the laptop showing the "installing update x out of y" screen for so long that I ended up looking online (using my phone) to see if there was a known problem with the update.

I usually have numerous folders and documents simultaneously open as I work, and it's a real pain to try and remember where I found that interesting resource.

So here's my plea to Microsoft, AVG and any other company that needs the whole computer to reboot – rather than just its own software – when updating: take a leaf out of Chrome's book, which manages to reopen all of the tabs after I restart them. Banish whole-computer reboots once and for all, or at least make it so that, if I do have to reboot, you will reinstate everything that I was working on when I had to restart. **Tony Fudger**

Always check your spelling when searching

If the advertisements served to me on the internet were relevant, fun to watch and not intrusive I'd have no absolutely problem with them.

However, I can't afford a Ferrari, have no need for women's underwear, don't require home-delivered ready meals, don't want to meet someone on a dating website or purchase pet

insurance, discover beauty, buy jewellery or any of the many things advertisers feel I need to know about.

The final straw was a plague of served-up ads featuring incontinence pants, in sizes small, medium, large, extra large and extra extra large, probably the result of a misspelt search. Long live ad-blocking!

Mike Tomlinson

Over and out

Thank you for the podcast for all these years. I thought something was "off" when it didn't go up one Wednesday evening as normal.

I am so going to miss all of you each week on my Thursday commute to the office. You have almost become friends whose voices I could recognise in a crowd. You always made me smile (especially when you got things wrong). You will be missed. Sisi Woods

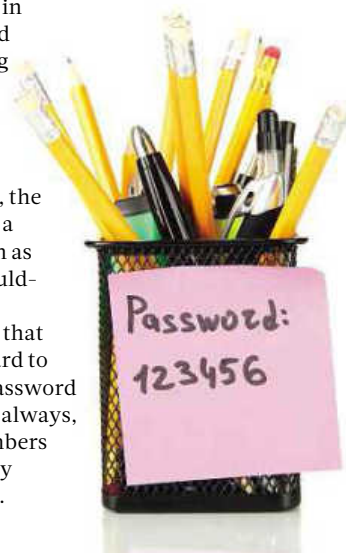
“The final straw was a plague of ads for incontinence pads, probably the result of a misspelt search”

m0r3 p455w0rd t1p5

Following on from Davey Winder's article about password security (see issue 253, p118), for some time now I have recommended that my less tech-savvy friends use another simple strategy to create strong logins. I said they should open a book they have around the house, then pick a page and line number within the volume and use their own set of tricks to capitalise, hyphenate and option substitutes.

It worked very well for a church-going friend of mine who uses *Songs of Praise* and writes down a hymn number, then uses the first line with a few twists. The secret is consistency in your tricks and not identifying the title of the book in your written password list.

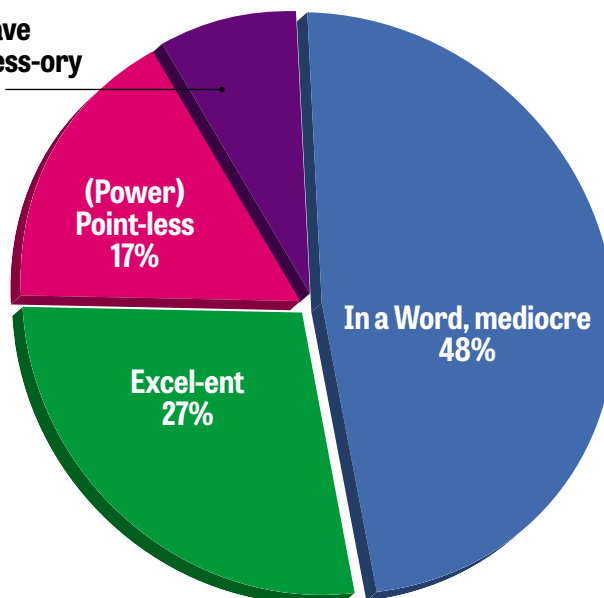
So, for him, the code 515 gives a password such as "He-who-would-Valiant-be," and it's a code that is almost as hard to crack as the password – provided, as always, that he remembers to take security very seriously. Colin Meech



Readers' poll

We asked you: what do you think of Office 2016?

A must have
business Access-ory
(8%)



There was a time when Office was an essential business tool. Its file formats are industry standards, and, if you wanted to swap files with another company, it was the only option on which you could depend with 100% certainty.

That's no longer true. It faces stronger competition than ever before from the likes of Google, Apple and LibreOffice. So after three years in development, we were hoping for something truly groundbreaking in Office 2016 to cement its position.

However, our reviews editor Jonathan Bray wasn't entirely impressed, proclaiming in his review that there was "not much to see here". It seems that almost half of you agree.

“A three-year wait for what, exactly?”

Pete Badrick

“Every release seems to be more and more about upgrade income. Different does not mean better, and change for the sake of it is not enough”

Terry Montague

“Three years to add a colourful theme seems like a poor return on the time waiting”

M Chapman

“Don't like the forced upgrade required by Office 365 Home. I want to use Office 2013 like I do at work”

Jeremy

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20 PROBLEMS WITH Windows 10

Have you been bitten by bugs after upgrading to Windows 10? **Dave Stevenson** explains how to solve the most common problems

Windows 10 is Microsoft's finest operating system yet, but it needed to be. Microsoft is being assaulted from all angles: by OS X on desktop, iOS and Android on handhelds, and consoles for gaming. Windows 10's positive reception – as well as our glowing five-star review – will have come as a relief to Redmond's anxious developers.

But Microsoft hasn't scored a hole in one. Windows 10 underwent a very long period of public testing, a nine-month beta gestation that should have hammered out the lumps, but didn't. A fair number of bugs and quirks remain.

The good news is that none of the glitches in question are likely to be showstoppers. Windows 10 is a stable, responsive OS, and there are plenty of reasons to hit the Upgrade button that appears to users of Windows 7 SP1 upwards. The reinstatement of an improved Start button, the introduction of speech-recognition search engine Cortana, and, finally, the "death" of Internet Explorer are all good reasons to get stuck in.

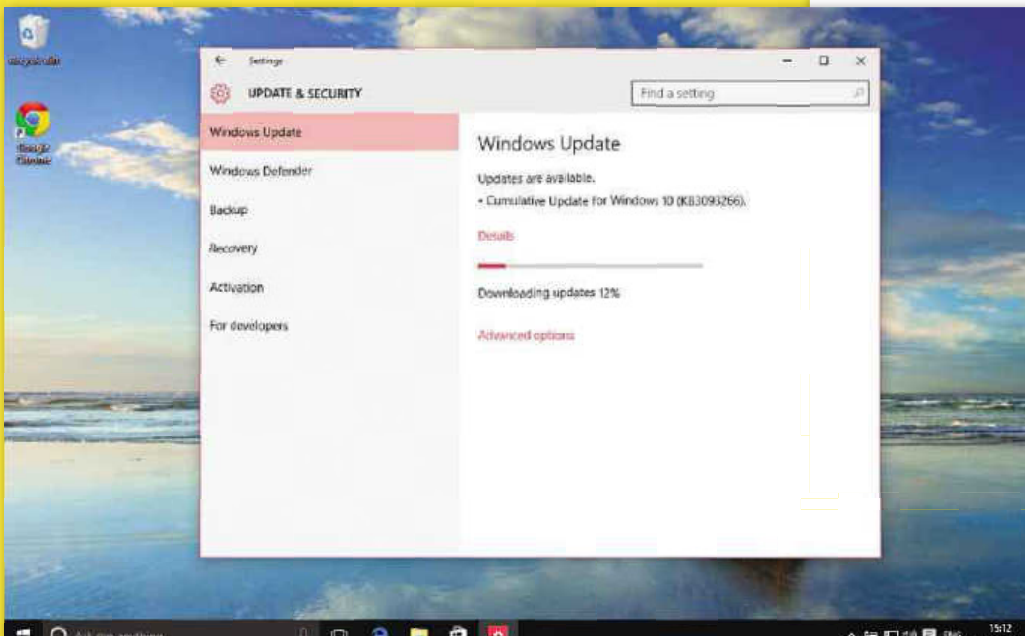
As for the bugs, we've got you covered. Here are 20 common problems with Windows 10 and how you can fix them forever, leaving you with a PC that has all of Windows 10's new features and fewer of its frustrations.

1 HOW DO I STOP AUTOMATIC UPDATES?

Automatic updates have been a thorn in the side of Windows users for years. Unprompted, unexpected restarts to install important updates can take users by surprise, leading to wasted time. Things are just as problematic in Windows 10, not least because the first round of updates was riddled with errors: users complained about updates partially installing then stalling. Updates were then rolled back, users' systems rebooted, and the whole process started again.

Some users claim success following simple perseverance, while others swear by manually installing updates individually. To do this, go to catalog.update.microsoft.com (this only works in Internet Explorer, not Edge) and enter "Windows 10" in the search box to see a list of compatible updates.

You could be forgiven for taking your PC's health into your own hands. Choose Settings in the Start screen, then "Update & security". Choose Advanced Options, then "Notify to schedule restart". This won't stop updates from downloading, but will at least prevent Windows acting on its own initiative when you pop downstairs for a cup of tea. Moreover, true control freaks can opt to defer upgrades. This doesn't stop security updates downloading and installing, but does put the brakes on everything else.



2 WHAT'S IN THESE AUTO-INSTALLED UPDATES, ANYWAY?

Microsoft wants Windows 10 to be more akin to a web service than a traditional operating system. Nobody knows which version of, say, Netflix they're using, and that's how Microsoft wants Windows 10 to work. Alas, that's achieved by obfuscating the update delivery process to the point where it's very tricky to keep track of what's being downloaded and installed, and what's coming

next. The positive spin is that users no longer need to worry about updates, as they happen in the background.

You can't stop Windows downloading important updates, meaning keeping track of downloads is largely an exercise in curiosity, but clicking Details under "Updates are available" will show you what Windows Update has in store. Hover your mouse over any of the impending updates and a textbox will appear telling you what each download entails. Infuriatingly, the textbox vanishes after five seconds, which makes reading longer passages difficult. To find out more, you can always highlight the update number (normally beginning KB), press Ctrl+C, and paste it into a search engine.

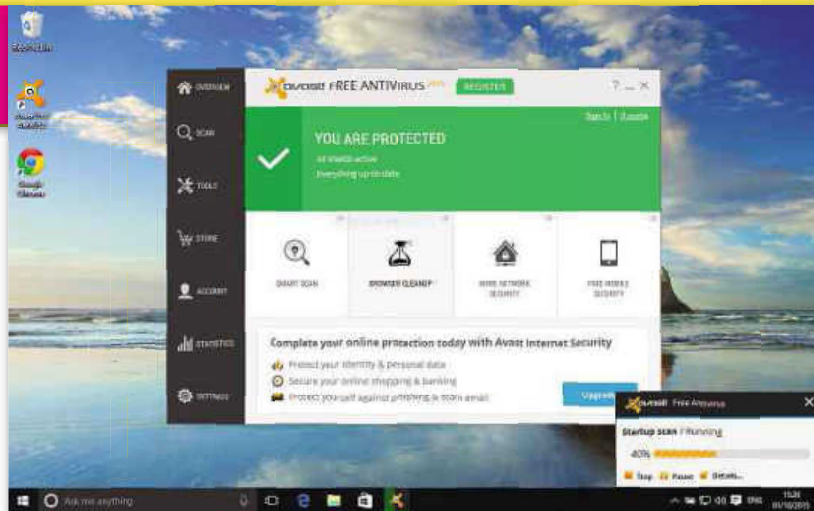


3 DO I NEED ANTIVIRUS SOFTWARE?

As with Windows 8, Windows 10 comes with antivirus software in the form of Windows Defender. Tightly woven into its host operating system, it's updated regularly and monitors your PC in real-time, as well as giving you the option to run manual scans if you suspect something's amiss. As out-of-the-box software goes, it's usable, easy to navigate and stops a reasonable proportion of threats. However, our independent testing revealed that it allowed 32% of threats through the net, prompting us to discourage users from relying on it.

Fortunately, there's still a sizeable market of third-party antivirus software, not least our favoured free choice, Avast Free Antivirus. It performed well in our tests, and gamers will appreciate its silent mode, which prevents pop-ups. It's also forgiving when it comes to installing new apps – you won't find it stirring into life every time you add new software to your PC. For those who can't tolerate the adverts in the free version, Avast Internet Security will set you back £40 per year, and is advert-free. It also adds useful features such as a firewall and anti-hijack protection, designed to protect you from phishing sites.

With Microsoft aiming for Windows 10 to be installed on a billion PCs worldwide by 2017, the tempting target presented by the world's most installed operating system isn't getting any smaller – you'd be advised to take precautions beyond Microsoft's own, flawed antivirus software.

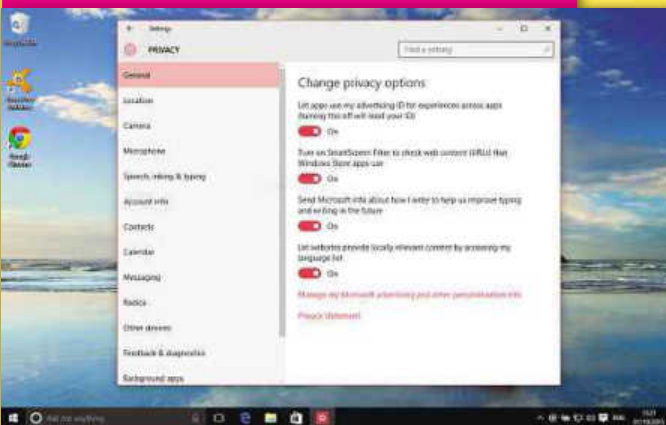


4 HOW DO I STOP WINDOWS CHEWING THROUGH MY 4G DATA?

One of Windows 10's biggest problems has been invisible internet use. Even before it was released, users spotted that Windows 7/8 PCs were automatically downloading Windows 10 in the background, to the chagrin of users with metered connections. This continues after Windows 10 is installed: background updates often weigh in at several hundred megabytes. That's inconvenient for forgiving home broadband connections, but a potential disaster on mobile internet accounts. To stop Windows 10 sucking down data in the background, go to Settings, then Network & Internet. Choose Wi-Fi and then Advanced Options. Toggle "Set as metered connection" to on, and Windows will stop getting non-essential updates, as well as turning off some app updates and Start screen tiles.

Puzzlingly, this doesn't work on PCs that connect to the internet via an Ethernet port, which is worth remembering if you've got several PCs wired to your internet router. One decent-sized update and you could find yourself over your data limit.

5 HOW DO I STOP MICROSOFT GETTING ALL MY PERSONAL INFO?



A tricky one, as Windows 10 handles more personal information than ever. Its ability to sync your browser history across devices will be valued by anyone with a desktop PC, a laptop and a Surface device, while Cortana's uncannily accurate speech recognition is a useful, futuristic touch. Meanwhile, OneDrive, Microsoft's Dropbox-beating cloud storage and document service, weaves pervasive online storage throughout the OS.

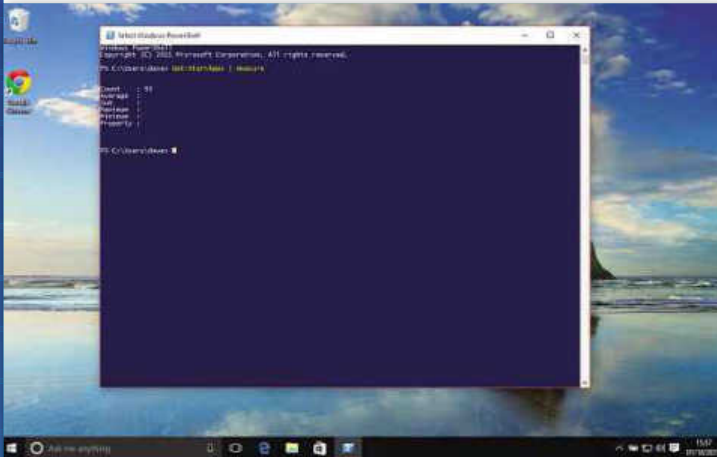
The bad news is that all this involves sending data to Microsoft. Syncing browsers across different devices involves transmitting your browsing history, bookmarks, favourites, saved website passwords and your wireless networks' names and passwords to Microsoft. Cortana collects data from your calendar and email, as well as your Bing search history.

There are deeper problems if you've taken the time to read Microsoft's user agreement. It's firm about its right to "access, disclose and preserve personal data" in order to "protect [our] customers", and the eagle-eyed will have spotted that Windows 10's advertising engine is based on "your likely interests or other information that we learn about you over time using demographic data, search queries, interests and favourites, usage data, and location data".

If that's made you nervous, head to Settings, then Privacy. Feel free to uncheck as many of the boxes as you like. Cortana can be put out to pasture by clicking the search box in the taskbar and then choosing the Settings icon (the cog). Slide Cortana to off. Finally, sync settings can be found in the Accounts section of the Settings panel, and can be turned off completely or individually.

6 WHY AREN'T ALL MY PROGRAMS IN THE START MENU?

This is one we hope Microsoft fixes soon. If your Start menu has more than 512 individual items in it, there's a chance they won't all show up when you click "All apps" after clicking the Start button. If you suspect you're affected, click the search bar and type "powershell". Then, enter "Get-StartApps | measure". This will show you how many Start menu apps you have. If it's more than 512, you might not see all of them. Microsoft says it's working on a fix.

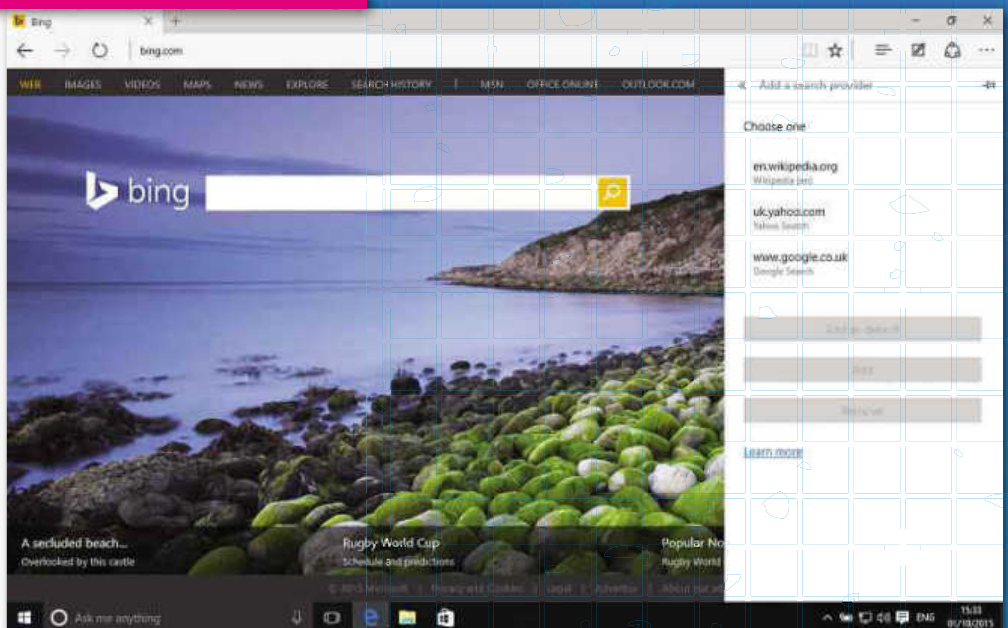


8 HOW DO I SWITCH THE SEARCH BAR FROM BING TO GOOGLE?

In a similar vein to the previous problem, Bing won't be for everyone. Anecdotal evidence around the *PC Pro* office is that it's improved in the six years since launch, but if you're used to your Google search history following you around on different devices, or simply prefer an alternative, it's still possible to change Windows 10's default search options.

If you want to use Edge, you can click the ellipses on the far right of the address bar and choose Settings, then Advanced Settings. The dropdown box for the default search engine will say Bing, but "Add new" will give you more options. In theory, anyway. For us, the alternative options list was blank. To fix this, go to your chosen search provider's homepage (Google, Yahoo and Wikipedia all worked for us), and refresh the list of alternative search providers. Your alternatives should now appear.

Changing the default behaviour of the search bar is trickier. Microsoft doesn't give you the option, leaving third-party kludges as the only way forward. If you want to use Google, set Chrome as your default browser and go to its web store. Find Bing2Google (free) and add it to Chrome. Web searches in the Windows 10 search bar will now fire up Chrome and deliver the results using whichever search engine is the browser's default. Pleasingly, the rest of the search bar – for finding apps and settings and so on – continues to work as normal.



7 HOW DO I STOP WINDOWS' DEFAULT APPS – SUCH AS EDGE – OPENING EVERYTHING?

Microsoft Edge is Windows 10's default browser, and, even if you're a die-hard Google Chrome or Firefox acolyte, it's worth a look. It's around a quarter of a million lines of code slimmer than Internet Explorer, and it looks better and is more standards-friendly than IE. It also ties in closely with Windows 10's password-management system and, in some of our tests, ran significantly faster than Internet Explorer – 20% faster in the SunSpider benchmark.

Still, if you've tried it and it's not for you, the classic alternatives – as well as more left-field choices such as Opera or Midori – are still options. If you found that upgrading to Windows 10 overwrote your previous default browser preferences, the System section of the Settings panel houses a Default Apps option. Click "Web browser" and currently installed alternatives should appear, along with the option to hunt for another in the Windows 10 Store.

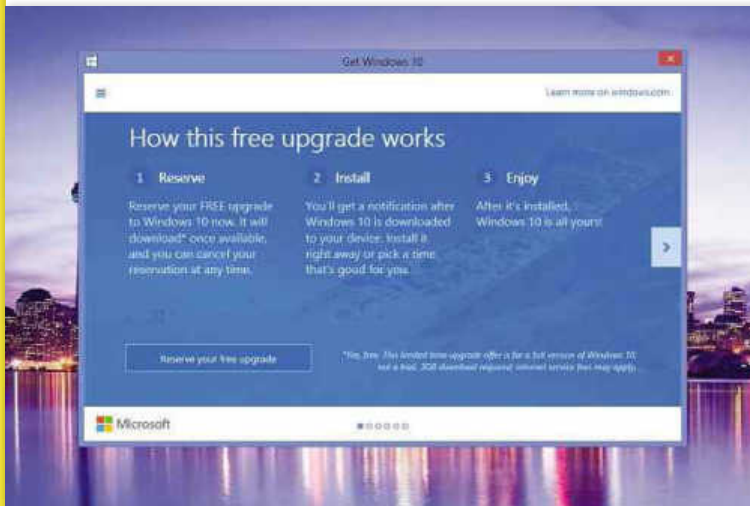
If you don't much fancy Windows 10's somewhat confusing Groove Music, you can reset it here as well. Windows Media Player is an "oldie but goldie", although our top choice continues to be the impressive, free, VLC Media Player (videolan.org).

9 WHEN DOES THE FREE UPGRADE OFFER END?

It's Microsoft's aim to have Windows 10 installed on a billion PCs by 2017, which is why, if you already have a Windows operating system from Windows 7 SP1 onwards, you can get the new OS for free.

It's possible to get a Windows 10 ISO for future use direct from Microsoft. As long as you have a valid product key, either for Windows 10 or a qualifying previous OS, it will still work.

The caveat to all of this is that users hedging their bets shouldn't be too cautious. Windows 10 will be free to install for a year after its release: Microsoft says the offer ends 29 July 2016, and free upgrade installations must be completed by then. A boxed or downloaded version of the OS will set you back £85.



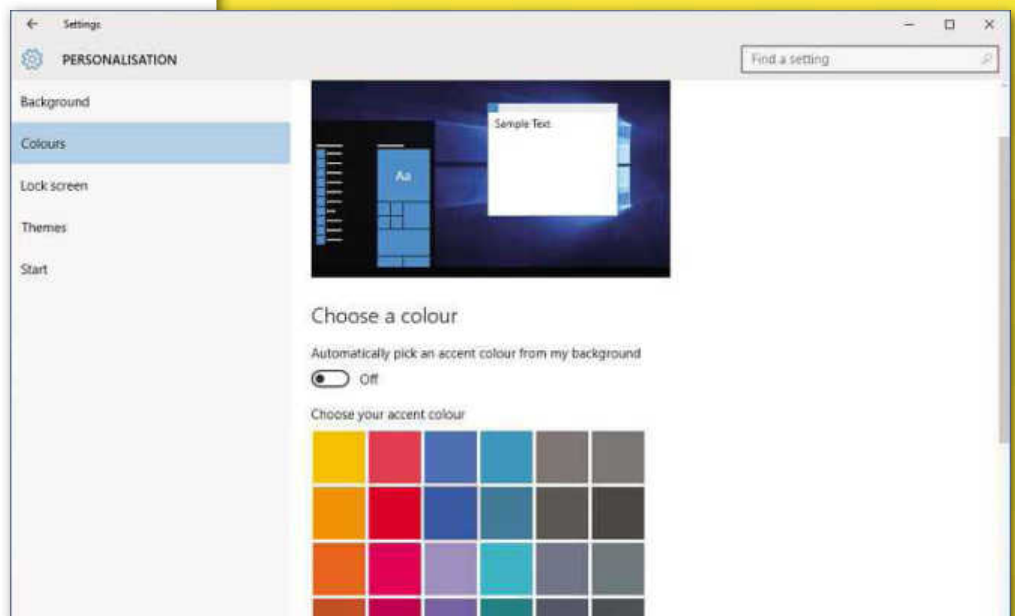
11 HOW CAN I TELL WHICH IS THE ACTIVE WINDOW?

Not all of Windows 10's aesthetic changes have proved popular, and the way every single window – active or not – has a plain white title bar with black text can make it very difficult to tell which is live. This poses problems for those with multiple monitors, or high-DPI displays that can accommodate lots of windows at once. The change has made at least one member of the *PC Pro* team pine for the days of title bars with customisable gradients.

The best workaround is to right-click the desktop and choose Personalise | Colours, then uncheck the automatic slider and pick a new accent colour. The difference is very subtle, but your chosen accent colour will surround the "live" window in a one-pixel-wide border.

Otherwise, choosing one of Windows' high-contrast themes gives you four options that colour the title bar, at the expense of Windows' aesthetic appeal.

There's a glimmer of hope in the future. Users with access to the Windows Insider Programme are reporting that build 10525 of Windows 10 restores the ability to choose a colour for the title bar.



10 HOW DO I LOG IN AUTOMATICALLY?

As Windows and Microsoft's personal accounts – whether you came to yours via Hotmail, Live, Outlook.com or Xbox – do ever more, security becomes more important. If, when you installed Windows 10, you gave it your Microsoft account details, your PC will already hold plenty of data. That's why, when you come to log in, you're asked for your password each time.

In practice, this can be a bit irritating. There's nothing like turning on your PC and going to boil a kettle, only to find you still need to log in and wait for your computer to load your startup applications. The medium-security solution is to go to Accounts in the Settings menu and choose Sign-in Options, then add a PIN number. These need to be at least four characters long. The lowest security option is to have your Windows 10 PC start without a password. Microsoft has buried the option to do this, but it is there.

Click the search bar and type CMD to load a prompt. Type "control userpasswords2", and uncheck "Users must enter a username and password to use this computer" in the resulting dialog box. Click OK and a new window will appear, into which you'll enter your existing password twice. Click OK and your computer will start up and log in automatically in the future. We'll leave it to your better judgement to decide whether this is a wise move or not.

Hummingbird [Colibri Thalassinus]

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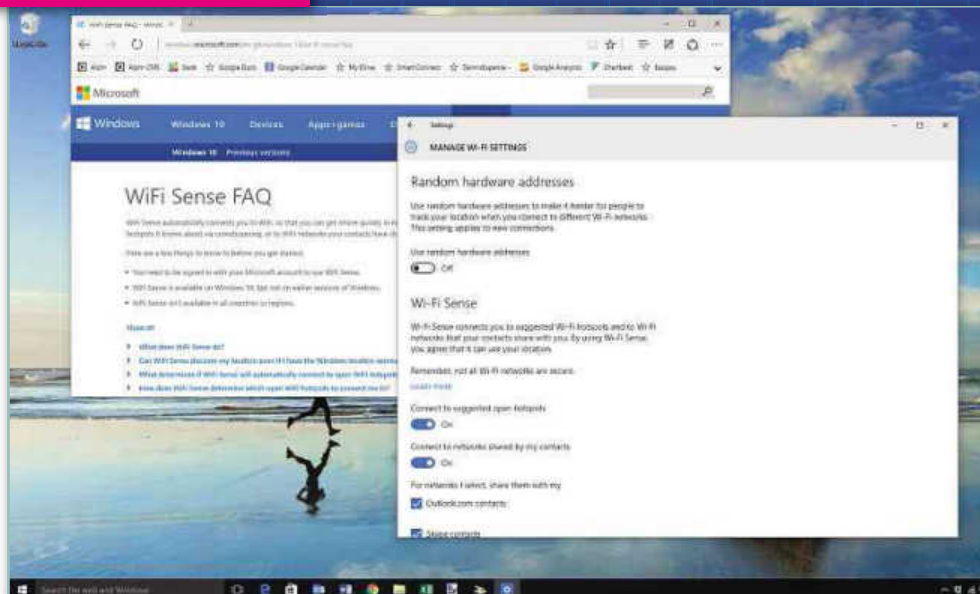
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12 WHAT'S THIS ABOUT MY WI-FI PASSWORD BEING SHARED?

If you've skimmed the Windows 10 headlines, you might have caught wind of how Windows 10 automatically shares your Wi-Fi password with all your contacts. The feature in question is called Wi-Fi Sense and will be familiar to anyone with a Windows Phone device. Every time you connect to a wireless network, the password you use is encrypted and stored on a Microsoft server. It's then shared, either with your contacts on Outlook.com, your Skype contacts, your Facebook friends, or all three groups simultaneously. The idea is that, if a friend from your contact list pops round, their Windows device will automatically connect to your wireless network without you needing to dictate an unwieldy password.

Network administrators will be hyperventilating at this point, and with good reason. For one thing, the average contact list in the *PC Pro* office is stuffed not only with trusted friends and colleagues, but PR contacts, business associates, plumbers, local restaurants and so on, and Microsoft admits you can't choose which contacts do and don't get to access your wireless networks. Microsoft protests that the shared Wi-Fi passwords, apart from being encrypted, will only allow guests access to the internet, rather than your shared folders and networked devices, but the cautious will still recoil in horror, as will those on internet connections with a bandwidth cap.

You can opt out of Wi-Fi Sense by unchecking "Share network with my contacts" when you first connect to a wireless network, but unless you lean over the shoulder of every Windows 10-using visitor to your home to make sure they do the same, permanently opting out is the only option. This is achieved via the horrendous fudge of changing your Wi-Fi network's SSID to include "_optout" at the end, which achieves the twin effect of stopping your Wi-Fi password being shared, and forcing you to reconfigure every device in your house so it automatically connects to your newly christened network.



13 WHY CAN'T MY LAPTOP PLAY DVDS ANYMORE?

Windows 10 brings a rude shock for movie fans: it no longer includes a DVD codec, which means you will have to supply your own. The good news is that if you upgraded from a version of Windows that could play DVDs, Microsoft is supplying a DVD decoder in the shape of its Windows DVD Player in the Windows Store. Versions of Windows that qualify include anything from Windows 7 upwards that included Windows Media Center – so the Ultimate, Professional and Home Premium versions of Windows 7, or Windows 8.1 with Media Center.

The offer won't last forever: Microsoft says everyone will have to buy Windows DVD Player for its full price of £11.59 "at or before" the free Windows 8 upgrade window closes on 29 July 2016. It might pay to be quick. Bearing in mind Windows DVD Player's price (and its average of two stars out of five rating on the Windows Store), it might also be worth considering VLC Media Player, which has always been free and can play DVDs.



14 HOW CAN I MAKE ONEDRIVE BEHAVE LIKE IT DID IN WINDOWS 8?

One of our favourite OneDrive features in previous versions of Windows was Smart Files. These were tiny placeholder files that showed up in your OneDrive folders, irrespective of whether the entire file had been downloaded to your PC. Open the file and the whole thing would be automatically downloaded, allowing you to preserve space on your PC or device until you actually needed it.

Smart Files are gone in Windows 10. Instead, you now choose which folders you want to sync with OneDrive. The drawback is that unsynced files won't show up in search – the only way to see all your OneDrive files is to either choose to sync everything, or to check your files at onedrive.com.

For users with bigger problems – such as OneDrive refusing to work at all – Microsoft suggests converting your Windows 10 account to a local account, and then back to a Microsoft account. You can do this in Settings | Accounts, and choosing "Sign in with a local account instead". Once you've done that, sign back in to your OneDrive account.



Emperor Penguin [Aptenodytes Forsteri]

The emperor penguin has four layers of scale-like feathers to protect them from icy winds as cold as -60°C (-76°F) and blizzards of 200 km/h (124 mph) and is the only animal to inhabit the open ice of Antarctica during the winter

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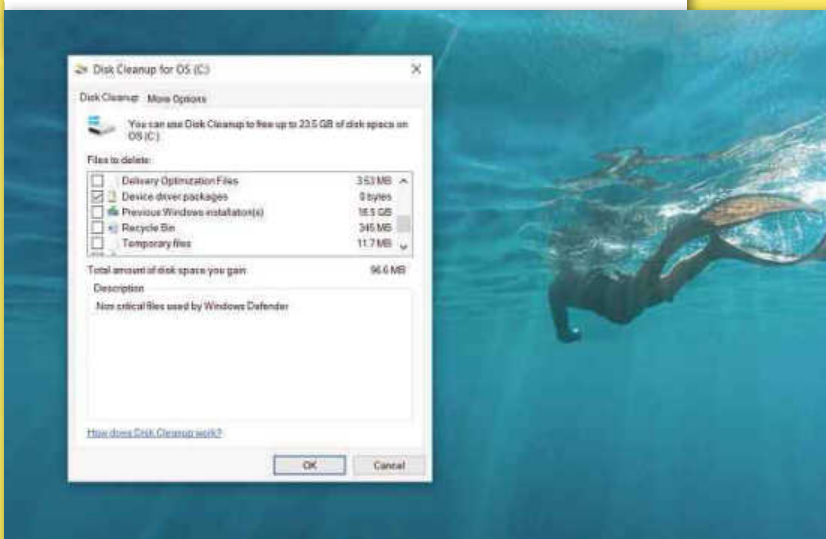




15 WHERE HAS ALL MY DISK SPACE GONE?

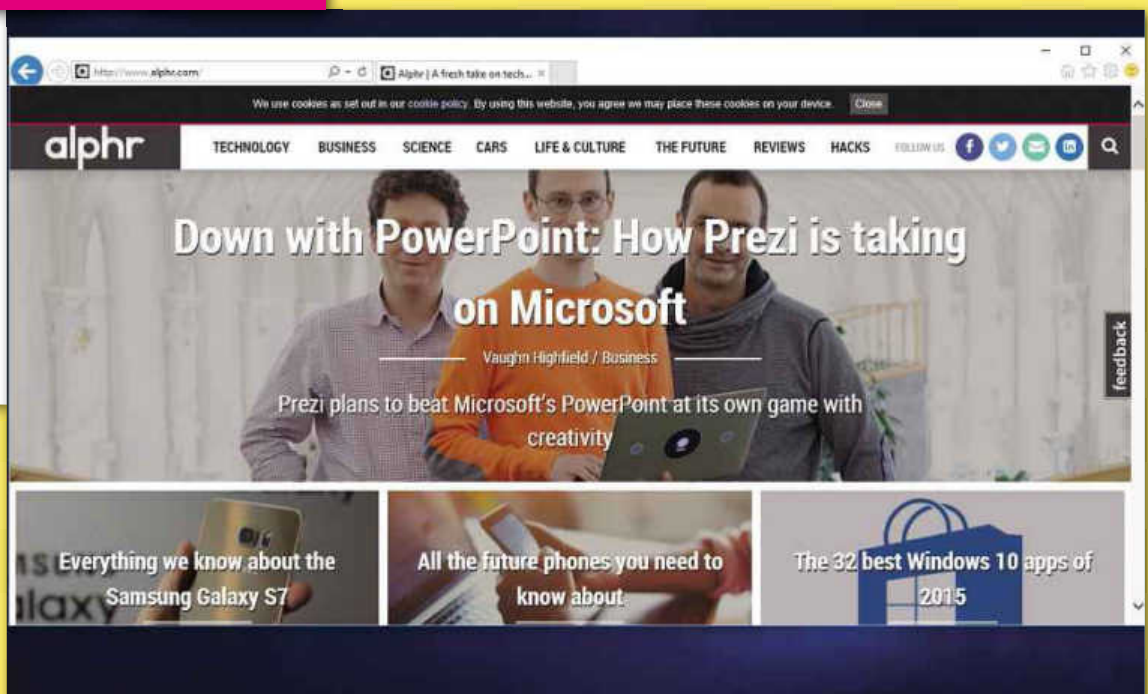
If you've upgraded to Windows 10 from a previous version of Windows, a handy thing has happened in the background. In the event you decide that Windows 10 isn't for you – or you find that a critical piece of hardware is no longer supported – you can roll your PC back to its previous state thanks to a folder called Windows.old, which contains your old Windows installation. The bad news is that this folder can be enormous – over 15GB is common – which can impinge on other things you want to do with your PC.

Further bad news is that Windows considers Windows.old a system folder, and therefore prevents you from simply dragging it to the Recycle Bin. To clear it, type “clean up” into the search bar and choose the top option. Click on “Clean up system files” and, after a wait while Windows searches through the system drive, you may see a “Previous Windows installation(s)” option. Select it, press OK, and space is your new friend.



17 WHERE HAS INTERNET EXPLORER GONE?

Our immediate question, given the superiority of Microsoft Edge and the availability of quality alternatives, is “why do you care?” But, if Internet Explorer 11 is your cup of tea, you can still use it in Windows 10. Type “ie” into the search bar to be rewarded with a rather old-school internet browsing experience.



16 WHY CAN'T I GET THE ACTION CENTER TO WORK?

One of Windows 10's more irritating bugs is an intermittent one: you go to open the Action Center on the right-hand side of the screen and nothing happens. The Action Center hides some pretty useful shortcuts, particularly if you're on a laptop, so its loss can be something of an annoyance. One easy potential fix is to turn the system icons – in what we would, until recently, call the system tray – off and then on again. Right-click the clock and choose Properties, then “Turn system icons on or off”. Turn everything off, including the Action Center, and then turn it back on again. The Action Center should spring back into life.

ESSENTIAL SHORTCUTS

Windows 10 has introduced a series of new keyboard shortcuts that make it easier to access new features. Here are a few of the critical ones:

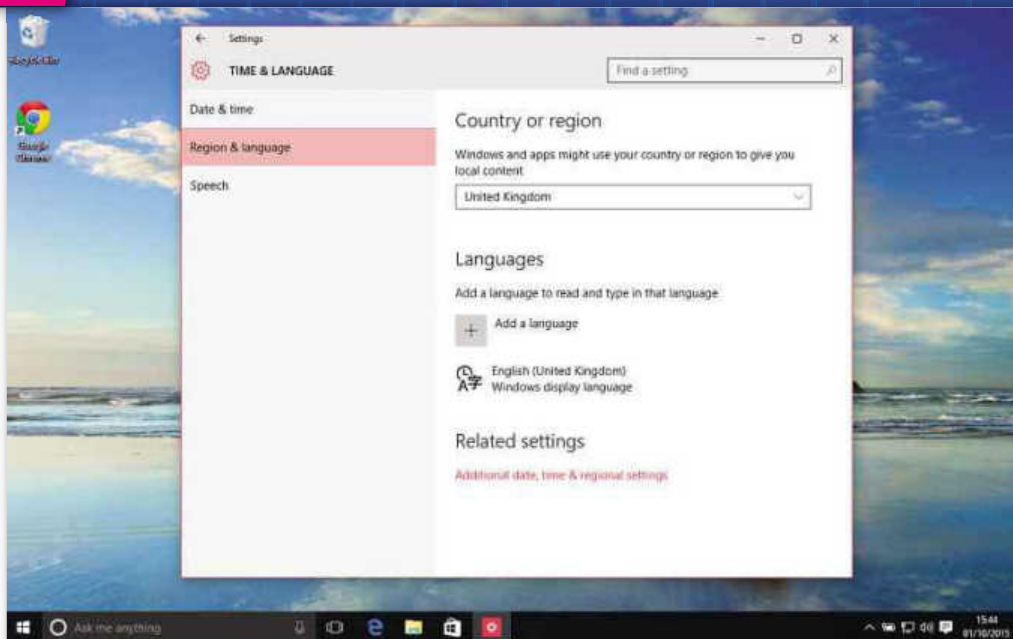
- ⊞ + A = Opens Action Center
- ⊞ + S = Opens search
- ⊞ + C = Opens Cortana in minimised “listening mode”
- ⊞ + Tab = Opens Task View
- ⊞ + Ctrl + D = Opens an additional virtual desktop
- ⊞ + Ctrl + right/left arrow = flip between open virtual desktops
- ⊞ + Ctrl + F4 = Close the current virtual desktop

18 WHY DOESN'T CORTANA WORK?

Cortana, Microsoft's much-vaunted Siri competitor, might not work out of the box due to a strange localisation bug. Click the search box on the taskbar and click the settings cog. If you see a message saying Cortana isn't available in your language or region when you know it is (the UK definitely qualifies), here's what you need to do.

First, go to Settings, then "Time & language". Choose "Region & language" on the left-hand side and click where it says "English (United Kingdom)", and choose Options. Click Download under Speech, and do the same under Language Pack, if it's available. Wait for both to download, then restart. When your PC has booted, click the search bar, then the Settings cog, and you should be able to activate Cortana.

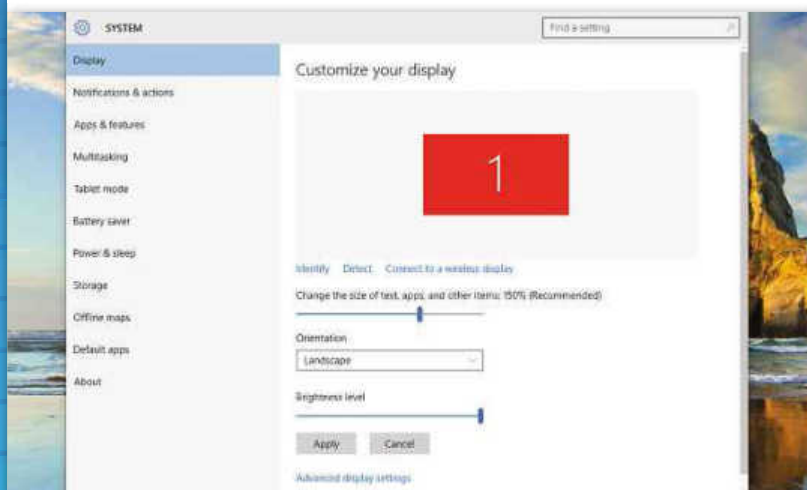
If you can't, go back to "Region & language" and change your country or region to the United States, and click "Add a language" under Languages. Find the English (United States) language pack and install it. Under Speech, choose English (United States), then reboot your machine. Activate Cortana, then change all your settings back to UK English. Reboot a final time and things should – fingers crossed – work.



19 WHY IS TEXT BLURRY ON MY HIGH-DPI DISPLAY?

If you have a high-DPI screen, whether on a PC or a Retina-compatible Mac, you're ahead of the technological curve. By and large this is a good thing, but every now and then you're going to find an app that doesn't work as well. Individual apps have to detect the DPI of the screen they're running on and scale upwards accordingly, so that text and image don't appear blurred. The list of compatible apps updated for high-DPI displays is growing all the time, but we're not quite there yet. If you open Display Settings (right-click the desktop), you'll be able to adjust your monitor's scaling to make very small text readable. The result, in non-high-DPI apps, will be readable but blurry text.

There's not much else you can do: every time you find an app that doesn't support Retina-class displays, pop the developer an email. With enough clamour, eventually all apps will support next-generation displays.



20 WHY HAS MY PRINTER STOPPED WORKING?

Malfunctioning printers are a perennial problem of PC ownership, but Windows 10 throws a few fun new quirks into the simple task of putting ink on paper. Plenty of users have complained about Windows' upgrade process nuking their printer drivers and leaving them with malfunctioning kit.

The good news is that, if your printer worked under Windows 7 or 8.1, it will almost certainly work under Windows 10 – you might just need to coax it into life. Open Settings, then choose Devices. If your printer appears, click it, then choose Remove Device. Next, opt for "Add a printer or scanner" and cross your fingers that Windows will find your printer: if it's attached via USB you've got fairly good odds.

If nothing appears, you still have options. The easiest is likely to be heading to your printer manufacturer's website and finding a driver package for Windows 10, although Windows' "My printer is a little older. Help me find it" feature may prove itself useful. For networked printers, you'll need to know your printer's hostname or IP address: if you have either of these, click the relevant option and pop in the appropriate details.



XBOX ONE

THE MUST-HAVE PC COMPANION

Barry Collins explains why the Xbox One console is the perfect partner for your Windows PC – even if you don't play games



When Microsoft announced in January that its venerable Media Center application wasn't

going to make the cut in Windows 10, many *PC Pro* readers doubtless let out a mournful sigh. The era of the front-room entertainment PC seemed to be over.

But Microsoft had its eye on the bigger picture. The Xbox One might be regarded merely as a games console, but its all-round entertainment capabilities make it a better fit for the front room than the full-fat Windows PC ever was.

The £300 block

of glossy black plastic is growing into a DVR, a media centre, a web browser, and a host for the same Windows Store apps you might run on PCs and tablets – and, of course, remains a fine games console. In fact, with Windows 10's ability to stream games from the Xbox to the screen of a laptop or tablet, it arguably circumvents the need to run games on your PC at all.

In short, the Xbox One is fast becoming a must-have companion device for the PC. Far from displacing the original vision of the Windows Media Center, it builds on it – just not in the shape of a conventional PC. In this feature, we'll explain the new features of Microsoft's console that make it the ideal partner to your desktop PC, and explore what it all means for the PC itself.

A BETTER MEDIA CENTRE

Microsoft's Media Center application was a curious anomaly. Adored by its users, and critically well received, it never managed to grow beyond cult status – even when noughties

PC makers created some delectable little media PCs to pop under the television. That said, we can point to many possible reasons for Media

Center's failure to go mainstream, most notably the advent of heavily

ABOVE Microsoft has refocused its media centre ambitions on the Xbox One

subsidised set-top boxes from the likes of Sky and Virgin Media.

So it wasn't a huge shock when Microsoft began to phase out Media Center in Windows 8, making it a paid-for extra rather than an integral part of the operating system, as it had been in Windows 7. When the final list of features for Windows 10 was announced in January, few were surprised that Media Center had been quietly phased out. Some pundits have even suggested that the entire concept has had its day: "Media Center's biggest value was the combination of the channel guide, DVR functionality, and the user interface," said Wes Miller, an

"When the final list of features for Windows 10 was announced in January, few were surprised that Media Center had been phased out"

analyst for Directions on Microsoft. "Today the content is coming in from everywhere, and there's an app on everything to play it. The death of Media Center, in many ways, was because of the sun setting on the television as the family's entertainment hub."

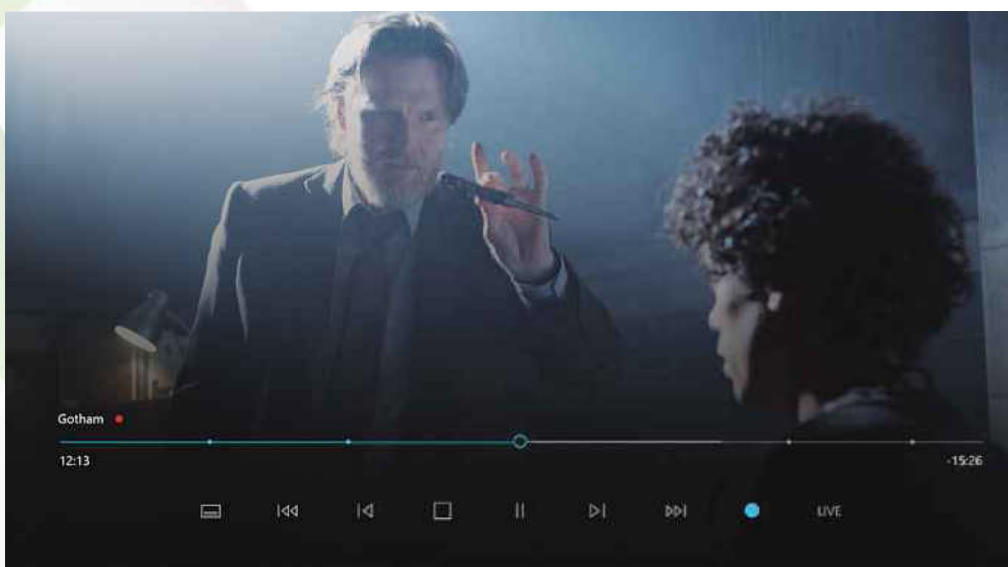
Yet Microsoft hasn't given up on its media centre ambitions – it's simply refocused them from the Windows PC to the Xbox One. The console will accept an HDMI input from a set-top box, and can support a USB TV tuner – so whether you prefer satellite, cable or Freeview, it will integrate cleanly with your set-top boxes, allowing you

to watch shows from within the Xbox One's TV app. You can also connect an IR transmitter to allow the Xbox One to control your set-top box; if you have a Kinect sensor, you can change television channels either using voice commands (although this is patchy, to say the least) or the Xbox controller. The Xbox even has its own electronic programme guide (EPG), allowing you to scan the schedules from the console.

Meanwhile, the Xbox SmartGlass app allows you to view the EPG on the screen of a Windows tablet, and use the device as a glorified remote control. You can even stream the TV signal itself from the Xbox to the SmartGlass app, effectively turning your tablet into a portable television.

Perhaps the best reason to connect your TV to your console is the option to snap the television picture to the side of the screen whilst you're using an Xbox app or game. This lets you keep an eye on the football, while enjoying your own game of FIFA, with the option to easily flick into full-screen if you can see a goal coming.

The one thing that's missing is DVR capabilities: despite the Xbox One's hundreds of gigabytes of available storage, there's no way to record television shows on your console. That's set to change with a major update rolling out towards the end of this year, which officially upgrades the Xbox One to Windows 10. As well as an updated app framework (see below), this will bring a new DVR feature that turns the Xbox into a true successor to Media Center, with features that Sky+ and TiVo set-top boxes can't match. As well as scheduling recordings from the Xbox EPG when you're sat in front of the television, you'll be able to set recordings remotely using the Xbox SmartGlass app on your smartphone.



You'll also be able to stream recorded shows from the Xbox to your mobile or Windows 10 devices – a feature that neither Sky nor Virgin's hardware can currently match. You can even download the recorded shows to a tablet or laptop, so you can watch on a plane or on the train to work.

However, there are a couple of catches. First, you'll need to plug in an external hard disk: even though the latest-generation Xbox One hardware comes with a terabyte hard disk, you're not allowed to store recordings on the internal drive, ostensibly to avoid interfering with the games stored on it. Second, while you can happily record Freeview shows, the DVR facility won't work with satellite or cable set-top box feeds. We suspect Sky might not have been keen to permit features such as downloading shows to mobile devices because of complex rights issues. Nevertheless, the Xbox One could well tempt viewers to make it their primary recorder.

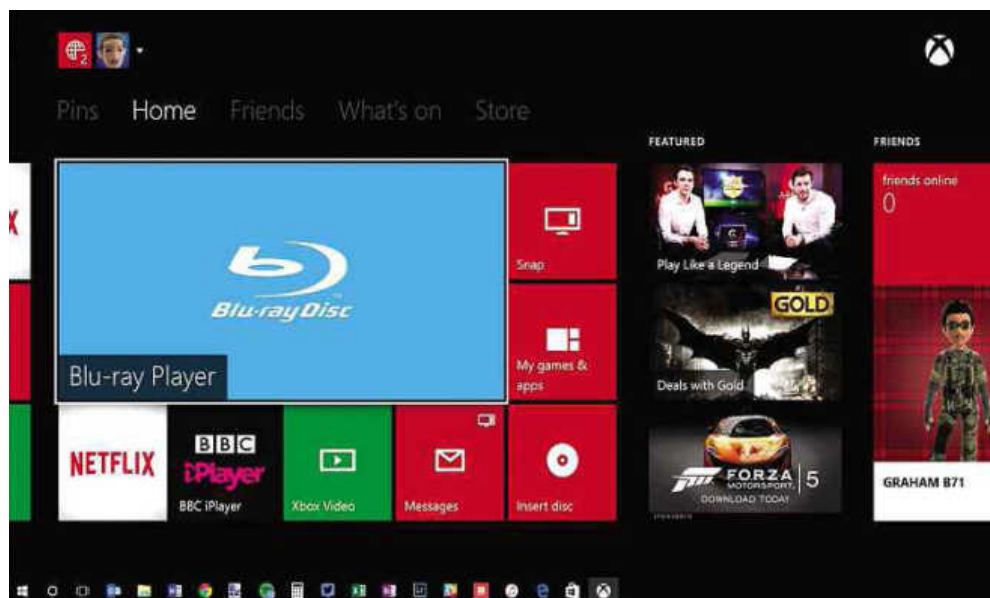
ABOVE You can download recorded TV shows to your tablet or laptop – to watch them later on the train

WINDOWS 10, APPS AND CORTANA

The Xbox One has long had its own library of native apps, as did the Xbox 360 before it. Predictably, most of them focus on video and entertainment. At the time of writing, the 100-strong library of downloads includes Netflix, BBC iPlayer, TuneIn Radio, YouTube and various apps

"You'll be able to stream shows from the Xbox to your Windows 10 devices – a feature that neither Sky nor Virgin can match"

BELOW An updated app network and DVR feature make Xbox One the next Media Center



for recording and sharing games footage. That means the Xbox One is already competitive with most other streaming devices, such as the Apple TV, Roku and Amazon TV.

With the Windows 10 update expected in November, that app selection could – and we emphasise "could" – be massively expanded. This will allow the Xbox One to run Universal apps from the regular Windows Store, just as on a PC, phone or tablet. Microsoft has publicly spoken of "thousands" of apps becoming available to Xbox One owners, with those already purchased on other platforms being eligible for free download.

Obviously, an app designed for a tablet interface may not translate perfectly to a console. Most Windows Store apps are designed for a touch interface, so they may be difficult to control, even with a Kinect sensor. Console users also sit some distance from the screen, while phone and tablet users have it pressed in front of their faces: text, graphics and icons will likely need to be resized to suit a 42in TV rather than a 10in tablet.

This means app developers will need to approach their Windows apps

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like modern websites, with responsive designs adjusting the user interface to suit the size and capabilities of the screen – and the Xbox store will only house those apps suited to run on the console. Head of the Xbox division, Phil Spencer, told developers: “We won’t see people using Excel on the Xbox, but Microsoft is making it easier to port experiences from PC over to Xbox where they make sense.”

So what types of app are likely to appear for the Xbox One? You could easily imagine services such as Spotify, eBay, weather apps, travel agents and fitness tracker Fitbit embracing the Xbox One – Microsoft will be throwing money at some big names when the console transitions to Windows 10.

Another Windows 10 import is Cortana. Those with a Kinect sensor may already be used to issuing voice commands to their Xbox, but the

“ You could easily imagine services such as Spotify, eBay, weather apps and fitness tracker Fitbit embracing the Xbox One ”

update will see Cortana make its debut on the console. It will take on many of the duties already assigned to voice controls, such as challenging friends on Xbox Live. Cortana will also work across devices. So, if you set a reminder on your Windows Phone or desktop PC to call your brother at 8pm, it will interrupt the movie you’re watching on the Xbox to remind you.



ABOVE The Xbox has its own electronic programme guide, allowing you to scan schedules from within the console

STREAMING FORWARD

Gaming is the Xbox One’s *raison d’être*. When Microsoft unveiled Windows 10 back in January, it wasn’t the blue-sky hoopla surrounding the HoloLens that got many people excited, but the ability to stream games from the Xbox One to Windows 10 devices.

The feature was switched on in one of the final Insider builds of Windows 10 before the desktop OS launched at the end of July. Instead of being tied to the living-room television, gamers can now wirelessly beam their games to a PC in a bedroom, or even a tablet. The receiving hardware doesn’t need to be powerful, as it’s essentially just receiving a video feed – all the processing is done on the Xbox.

Plug an Xbox One controller into a USB port on the receiving PC and you can play as if you were sat in front of the television. At first, streams

were restricted to 720p, but an update has boosted the maximum stream quality to 1080p at 60fps. As long as your wireless router has sufficient

bandwidth (see right), and your receiving device has a high-res screen, you can play remotely in Full HD, with no compromise to graphics quality.

It’s a capability that raises questions about the future of video games. Gaming on Windows has been in decline for years: you’ll struggle to even find PC games in many high-street retailers these days. Xbox streaming potentially turns even lowly £100 compact tablets into 3D-gaming machines, and while there’s still a market for those who want to play Crysis at punishingly high frame rates on 4K screens, most gamers will settle for the Full HD output from an Xbox, especially if it means not having to upgrade their graphics card every couple of years.

There’s another difference between PC and console gaming: the controls. Many still prefer a keyboard and mouse to a handheld controller, and the Xbox One will offer support for these in games. Once the console moves to Windows 10, there may be no discernible difference between playing a game on the Xbox One and on a regular PC. Xbox owners can already play online against PCs, and parity of controllers could see even more titles span both console and PC.

The distinction between the Xbox and a PC is becoming very blurred. Soon, the only difference between the two will be the user interfaces. The Xbox One hasn’t just become a must-have companion for your PC: it’s become a PC in its own right. ●

THREE THINGS YOU’LL NEED TO MAKE YOUR PC AND XBOX WORK IN HARMONY

A DECENT DUAL-BAND ROUTER

Streaming Full HD games and videos across your home network requires plenty of bandwidth. If you can’t run a wired Ethernet connection between your PC and console, you’ll need a decent wireless connection. In our experience, an 802.11ac router is your best bet for reliable, stutter-free games streaming. If you’re still on 802.11n, that doesn’t have to ruin your fun as long as your network isn’t too prone to congestion and interference: switching to the 5GHz band, rather than the default 2.4GHz band, can help.



THE XBOX ONE SMARTGLASS APP

Now available on iOS and Android, and for Windows mobiles and tablets, SmartGlass acts as a fancy remote control for your Xbox One. If you run your television through the console, the SmartGlass app hosts the electronic programme guide (“OneGuide”), allowing

you to switch channels without having to reach for an Xbox controller or rely on the finicky voice controls. A forthcoming update will add the facility to remotely schedule television recordings from your smartphone.

KINECT

Microsoft originally made the Kinect a mandatory part of every Xbox One bundle. It’s since dropped that requirement, but if you want to use your Xbox One as a DVR it’s a wise investment. The Kinect includes IR emitters that can be used to change the TV channels on your set-top box. If you don’t have a Kinect, you can buy emitters separately, but that can create an ugly tangle of wires under your television. Kinect voice commands also make it easier to perform basic functions on the Xbox One, such as snapping the picture to the side of the screen.



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HOW **SECURE** IS YOUR SMARTWATCH?

The smartwatch is rapidly growing in popularity, but do wearables constitute a serious security risk? **Davey Winder** investigates

How long does the battery last? Should I opt for Apple or Android? Can I pay for my lunch with it? The list of smartwatch FAQs has one glaring omission: how secure are the damned things?

While everyone – *PC Pro* included – focuses on the magnificent features and longevity of these supercharged wristwatches, it seems nobody is talking about smartwatch security. How hackable are these devices? Are they susceptible to malware? Will they divulge your personal data if they're lost or stolen? Can they even be wiped remotely?

We routinely ask such questions about our smartphones, the devices that wearables are inextricably paired with. Yet early adopters and the media – who don't normally shy away from potential scare stories – have been unusually quiet when it comes to smartwatch security. Both, it seems, have been complacent about the risks.

MORE THAN A DUMB DISPLAY?

One of the big hurdles that must be overcome when talking about smartwatch security is accepting that it's a genuine concern in the first place. After all, isn't the gadget on your wrist just a dumb mini-monitor for the smartphone in your pocket? That's certainly a common perception, along with the notion that, as long as the data on your smartphone is secured, the watch is of very little consequence.

The reality is rather different, as researchers from Trend Micro recently discovered when they conducted penetration testing on some of

the most popular smartwatches on the market. The Apple Watch, Motorola Moto 360 and Pebble watches were among those tested for their hardware protection, data connections and local data storage. "It's clear that manufacturers have opted for convenience at the expense of security," Bharat Mistry, cybersecurity consultant at Trend Micro, told *PC Pro*. "We discovered that all of them saved data down locally, which enables a hacker to access the data when the watch is taken out of range of the smartphone it's paired with."

Both Apple- and Android-powered watches store unread notifications, as well as fitness and calendar data. The Apple Watch adds images, contacts and Passbook information to the list of data stored locally. "As Passbook information can contain highly sensitive data such as plane tickets, smartwatch owners need to be as careful with these devices as they would with their smartphones," Mistry warned.

The idea that synced local data can be read through the watch interface is concerning, but the fact that the Apple Watch stores so much of it is of even more troubling. Trend Micro's research exposes the misconception that smartwatches are only smart on the outside.

HP has also recently carried out research into smartwatch security, and the results don't make for comfortable reading. Once again, all of the tested devices contained vulnerabilities, with HP branding smartwatches "a new and open

frontier for cyber-attack". HP Fortify raised particular concerns about insufficient user authentication, insecure web interfaces that potentially enable hackers to identify user accounts through password-reset mechanisms, and poor encryption of data in transit. The latter is of huge concern to those in the security business. While all the devices implemented SSL/TLS, HP found that 40% of the watches were either vulnerable to POODLE attacks (a well-known, and relatively easy to mitigate, man-in-the-middle exploit of transport encryption mechanisms)

or still using old protocols such as SSL 2.0.

Simeon Coney, chief strategy officer at AdaptiveMobile, believes that the potential to ping unauthorised

messages to users is a major concern. "Smartwatches compound one of the primary security risks already prevalent on mobile phones, which is that they encourage users to 'glance and respond' to notifications," he said. This means attackers can exploit this behaviour to contact the user with interactions that aren't scrutinised for legitimacy in a way that they would if they, for example, received an email on their PC. "Any interaction where the user is either not given enough information to determine its legitimacy or where the device, or ecosystem, does not provide automated security scanning before

"IT'S CLEAR THAT MANUFACTURERS HAVE OPTED FOR CONVENIENCE AT THE EXPENSE OF SECURITY"



delivery could be exploited,” he added.

Then there’s the small matter of firmware updates being transmitted without any encryption of the transport mechanism or the update files themselves. This isn’t quite so worrying, as most updates are signed to prevent malicious installs, but the lack of encryption does make for easier downloading and analysis by the crooks. It also suggests that manufacturers are guilty of concentrating on the design and features of smartwatches, at the expense of designing functional security into the devices from the get-go.

MALWARE O’CLOCK

Ken Munro, senior partner at Pen Test Partners, is a professional penetration tester and thinks part of the security problem with smartwatches is that they have evolved to run fully fledged operating systems that can connect to the internet independently. “We should expect more targeted attacks,” he told *PC Pro*. “The apps for smartwatches tend to request every permission under the sun. If malware can be uploaded, or if a malicious app is installed on the watch, it could potentially access a lot of data.”

Isn’t the malware threat really to the phone itself rather than the wearable? Is there any evidence that smartwatches are even being targeted by malware writers, either from the standalone perspective or as a conduit to get at that valuable data stored on a paired smartphone? “Currently we are not yet seeing many attacks on smartwatches,” said Jahmel Harris, information security consultant with MWR Labs, who expects attacks to become more common as users adopt mobile payment systems.

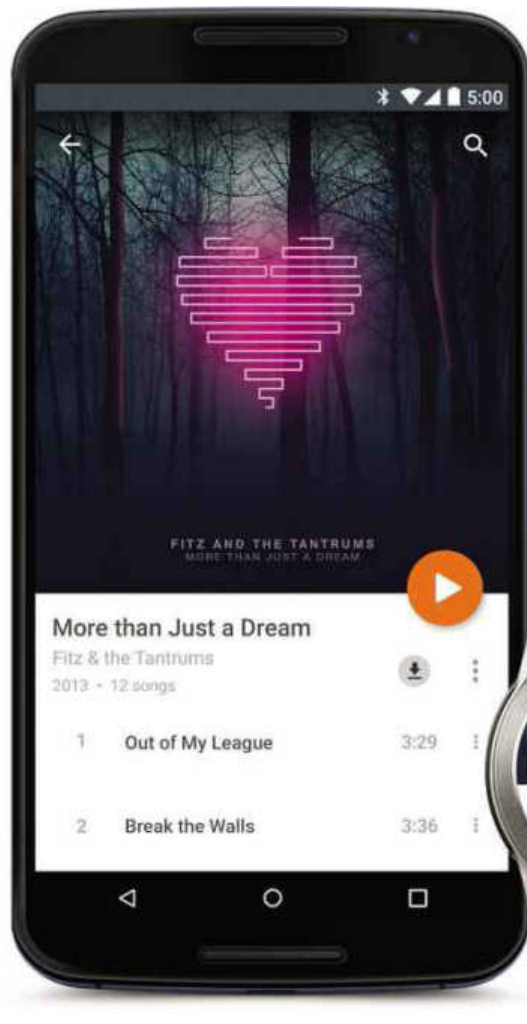
Harris added that both Google and Apple have gone to great lengths to protect against the type of attacks that would allow malware to spread from watch to phone, but warned that “applications could be installed covertly on some smartwatches that behave differently to the software running on phones, making it more

challenging for security researchers to analyse malware”.

What smartwatches have going in their favour, at least for now, is that they are relatively niche. In other words, they haven’t exactly become the phenomena that some had predicted and, as with all minority operating systems, the smaller the installed base, the less attractive the target.

Smartphones are much more common than smartwatches, hold more sensitive data, have greater processing power for launching attacks, and have direct connections to external networks. “It just doesn’t make sense for someone to go to the trouble to target a smartwatch, when it would likely be more difficult and have less payoff than targeting the phone itself,” said Chris Camejo, director at NTT Com Security. “The only scenario I could think of is a ridiculously easy-to-exploit vulnerability in a smartwatch, but any such vulnerability would likely be patched quickly.”

LEFT Malware attacks could spread from watch to phone



PRIVACY ON PARADE

If malware isn’t a threat to your data, maybe you are. Think about it for a moment: who else is reading those texts or emails that are being displayed on your wrist? What about two-factor authentication codes if they pop up as alerts on the watch? Is inadvertent data sharing, also known as “shoulder surfing”, likely to be a major threat to your privacy? Chris Camejo thinks that the always-on (as in physically always on your wrist) nature of the device carries a far greater risk than a smartphone, which is often kept in a bag or pocket. Much of this information, he surmises, would have greater potential for embarrassment than malicious compromise. “Two-factor codes are generally useless without another piece of information, such as a PIN, password or certificate,” he explained. “While we could dream up some scenarios where shoulder-surfed data could lead to a breach, these would likely be contrived.”

Bharat Mistry disagrees from a purely data-privacy perspective: “The controls on these devices are relatively immature, so there is a big risk of inadvertent data sharing,” he warned. “If a user forgets to lock a device, there is the potential for other people to view notifications that pop up on their watch.”

Indeed, the lockscreen would appear to be the best defence when it comes to preserving privacy. Android Wear, for example, is now shipped with the same lockscreen used by Lollipop smartphones, in the form of Keyguard. “Locking a phone can stop an attacker from reading messages. However, unless a lock is set on the watch, a casual glance can reveal a lot of potentially sensitive information,” said MWR’s Jahmel Harris.

If not through shoulder surfing, then how might data privacy be

BELOW The Apple Watch has a setting that wipes all data after ten failed passcode attempts





A casual glance at a smartwatch can reveal plenty of information

vulnerable? The synchronisation of data via Bluetooth and Wi-Fi poses another risk. “This creates an interesting attack angle, but is likely to require physical proximity to exploit a specific user,” said Simeon Coney. Then again, it has become apparent that Apple’s AirDrop is being used to send unwanted content to users. If this makes its way to the watch it could be used to push

“THINK ABOUT IT FOR A MOMENT: WHO ELSE IS READING THOSE TEXTS OR EMAILS THAT ARE BEING DISPLAYED ON YOUR WRIST?”

malicious messages or phishing “by pushing seemingly legitimate prompts for PIN codes, passwords or other credentials,” Coney warned.

Maybe the biggest privacy risk is theft. A smartwatch may be harder to lose than your phone, by virtue of being strapped to your wrist, but should a strap break or you forget to pick up your watch as you leave your hotel room, it’s vulnerable. Scott Lester, senior researcher at Context Information Security, reminds us that there is no “find my watch” feature for Apple users, “but there is at least a setting to wipe after ten failed passcode attempts”. When it comes to Android Wear, users with devices that can connect to Wi-Fi do have the

ability to remotely revoke them, although this still won’t wipe the data from the device.

APP ATTACK

Finally, what about the apps and any safeguards that are being built into app design to prevent attacks? Mark James, security specialist at Eset, is convinced that “apps will almost certainly be the biggest single failure we will see in this market”.

According to MWR Labs, developers are often unaware of the changes that have been made to smartphones that allow them to communicate with their respective smartwatches.

“Android Wear requires developers to create a service in their application, effectively creating an opening that is required to communicate data between Android and Android Wear,” Jahmel Harris from MWR told *PC Pro*. “In theory, this service can only be used by Android Wear, but our research has shown it’s possible to communicate with this service from a rooted wearable.”

As a weakness in one may put the other at risk, it is particularly important that security controls such as root detection, obfuscation and integrity checking are performed on both the applications written for Android Wear and Android itself. “In the case of Apple Watch,” Jahmel

Which smartwatches would the experts trust?

Would our security experts trust one smartwatch platform over another? Here’s what they told us:

Bharat Mistry from Trend Micro backs... Apple

“Physical device protection across all smartwatches is very poor. Our research found that none of the authentication via passwords or other means is enabled by default. This means that free access could be achieved if the wearable was stolen. All devices, apart from the Apple Watch, failed to contain a timeout function, meaning that passwords had to be activated by manually clicking a button and leaving the devices vulnerable if left unlocked. The Apple Watch is also the only smartwatch we tested that allows a wipe of the device after a set amount of login attempts.”

Paul Le Messurier from Kroll Ontrack backs... none of them

“Regardless of the vendor or OS, smartwatches contain some serious security vulnerabilities, from insecure interfaces to insufficient user-authentication systems. However, while it is possible to hack a wearable device, there simply isn’t enough data contained on smartwatches to make the challenge of hacking one worthwhile. For now, users should be more concerned about where their data is being shared and stored, as the real target for hackers is the manufacturer’s cloud system to which your device is synced.”

Chris Camejo from NTT Com Security backs... Apple

“Historically, Apple’s approach to security on the iPhone has had quite a bit of success. The closed-platform, walled-garden App Store, rapid closing of jailbreaks and other security vulnerabilities, and overall software design have combined to make iPhones fairly resistant to attacks. The Android platform, on the other hand, is very fragmented and harder to patch consistently. The result is that most mobile malware affects Android but not Apple’s iOS. It wouldn’t be too far-fetched to expect that the trend will continue, with the Apple Watch being a more secure but more limiting platform, while Android is wide open but exposes more vulnerabilities.”

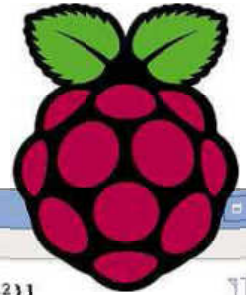
added, “MWR has seen developers weakening the security of the iOS application in order to allow sensitive information to be passed to the smartwatch.”

Making sure these apps are clean and originate from known sources will be a big responsibility for watchmakers. As Mark James concludes: “Making sure the app design, submission and distribution is meticulously monitored is the only way to protect the users.” ●





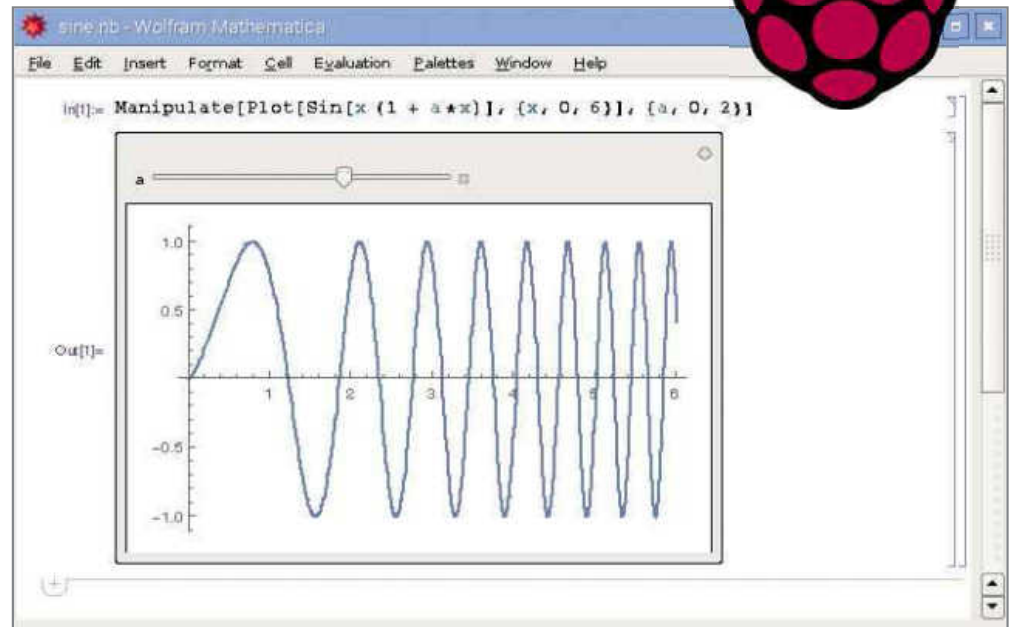
MACHINE LEARNING IN MATHEMATICA



Kevin Partner explores how to use Mathematica on the Raspberry Pi to do more than just add up



Kevin Partner is an author, web developer and Raspberry Pi fan @kevpartner



Since last year, the Raspberry Pi has come bundled with a copy of the computational program Mathematica – making it the first computer to come with the software since Steve Jobs’ NeXT in the 1980s. While Mathematica is best known as a tool for helping university students understand and use various mathematical techniques, it can also be used as a specialised programming tool, and a gateway to the Wolfram Alpha knowledge engine. The Home Edition of Mathematica for Windows, OS X or Linux costs £234 – so the fact that the Raspberry Pi comes with free access to this huge repository of data and powerful algorithms is exciting.

Although the software that ships with the Pi is described as a “pilot release”, it’s an almost complete implementation of Mathematica 10, the latest version. That means it’s a serious piece of software, so things will get a little sluggish once you start exploiting its more sophisticated and powerful features. It will work on any Raspberry Pi, but I think it’s only really usable on the Raspberry Pi 2.

Writing code in Mathematica is a steep learning curve, as the

idiosyncratic Wolfram Language bears little resemblance to other mainstream programming languages. Most languages have a relatively small set of native elements that can be combined by programmers into libraries or full working projects. The Wolfram Language, by contrast, comes with a bewildering array of specialist functions built in. This ensures that all functions work in a consistent way and efficiently build upon other elements of the Language. The net result is that the Wolfram Language covers some areas in great depth, but others not at all.

One of the key features of the Wolfram Language is that it’s “symbolic”. This means that everything is a symbol – whether it’s a simple variable, 3D graph or an entire program – and any part of a piece of code can be manipulated by the Language. For example, the EdgeDetect image-processing function doesn’t care whether it’s sent a photo, line art or a dynamically generated 3D chart. Thanks to this consistent approach, applications written in the Wolfram Language work across all sorts of purposes and platforms, removing the need to write bespoke code for different types of input and device.

ABOVE This interactive sine waveform was created with a single line of code

Mathematica also makes it simple to build interactivity into its output. For example, you can create a sine waveform with a single line:

```
Plot[Sin[x(1 + 2*x)], {x, 0, 6}]
```

To turn that into an interactive chart, simply use the “Manipulate” keyword:

```
Manipulate[Plot[Sin[x(1 + a*x)], {x, 0, 6}], {a, 0, 2}]
```

All we’ve done is wrap the command in a “Manipulate” function, changed the number 2 to the variable “a”

and added a series of parameters specifying that “a” is the variable to alter, and that it can range from zero to two. This is a powerful capability, especially for educational purposes where the

results of an equation can be hard to visualise.

The Wolfram Language is enormous and takes in hundreds of keywords and expressions, so the best way to get started with Mathematica is to find a suitable task and work out how to implement it.

Let’s begin with something simple – plotting the rainfall in your location

“Mathematica for Windows, OS X or Linux costs £234 – so that the Raspberry Pi comes with free access is exciting”

last year. On your Raspberry Pi, click the Mathematica logo on the menu bar to open the Mathematica interface with an empty document, or “notebook”. You’ll see a plus sign in the top left, which can be used to select how you want to enter your code. One very powerful aspect of Mathematica is that you can enter free-form queries and it will both provide a response and show you the equivalent Wolfram Language code.

Each notebook is made up of a series of cells, each of which contains one or more inputs that are evaluated by Mathematica. To plot the rainfall data, type the line below and press Ctrl+Enter to evaluate it.

```
DateListPlot[WeatherData[$GeoLocation,"TotalPrecipitation",{2014,1,1},{2014,12,31},"Week"}]]
```

After a few seconds, this will generate a line graph of the weekly rainfall between those dates at your location – all in a single line of code.

The data comes from Wolfram Alpha, which can supply a huge range of information. Visit wolframalpha.com to browse through the data categories and see examples such as movie box-office receipts to the locations of various spacecraft. Let’s explore more of that data: on a new line in your notebook, press Ctrl+= to open the discovery box, type Voyager 2 and press return to generate an object that represents the space probe. We can now find out how far away it is:

```
DeepSpaceProbeData[Voyager 2, "DistanceFromEarth"]
```

The reference to Voyager 2 represents the object shown within an orange box in the Mathematica interface. A query such as this might not seem useful on its own (because you could just have asked Google), but a great strength of Mathematica is that it allows you to create sophisticated queries and present the results graphically. For example, we could generate a chart showing the relative distances of all deep space missions with a couple of lines of code.

Moreover, the Wolfram Language is capable of much more than just retrieving data and presenting it. Mathematica offers machine learning functions similar to those that enable Google’s Photos app to recognise people and scenes. This may be of particular interest to Raspberry Pi owners, as there are a number of

Pi-based photography projects, including remote camera traps that capture an image of an animal when it triggers an infrared sensor. Since Mathematica can control the official camera module of the Raspberry Pi, it should be able to identify particular species from photographs.

Let’s give it a try, and see if we can train Mathematica to identify whether a photo is of a cat or a dog. You can see the complete code in the screenshot (see right) or follow a YouTube video at pcpro.link/254programming.

Begin by creating a new notebook in Mathematica. Press Ctrl+=, type “cat breeds” and press return to create the entity “domestic cat”. Immediately after the entity, type “// EntityProperties” and press Shift+Enter to evaluate the cell. This brings up a list of cat properties: copy “image” into the clipboard.

Now, change this first input cell so it reads as below and press Shift+Enter.

```
catpics=cat breeds[image]
```

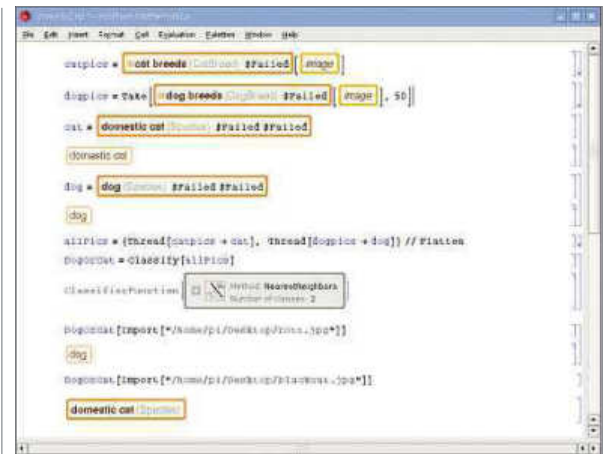
After a few seconds, Mathematica will display all the images associated with the entity cat breeds. Now that these are safely stored, we need to do the same for dogs, so scroll down the page until you see the horizontal line with a plus symbol to start a new cell. Follow the same process to “discover” the dog breeds entity and its image property. Wolfram knows hundreds of dog breeds, but we only want to import 50 images:

```
dogpics=Take[dog breeds[image]],50]
```

Now we must create cat and dog entities for Mathematica to link to the pictures. On a new line press Ctrl+= and type “cat” before pressing Enter, and you should get the entity “domestic cat”, which you should assign to the variable like this:

Try Wolfram in the cloud

If you don’t have a Raspberry Pi, you can try the Wolfram Language via the Wolfram Programming Cloud (pcpro.link/254wolfram), which aims to be an online equivalent of the desktop version. However, when you sign up for a free account, you’ll find some functions are limited, and you can only make a certain number of calls to Wolfram Alpha per month. Paid-for subscriptions to the Programming Cloud start at £18 per month – so if you want to experience the full power of the Wolfram universe, the Raspberry Pi is the cheapest way in.



ABOVE This is all the code you need to create a machine learning system in Mathematica

```
cat=domestic cat (Species)
```

Repeat this with the dog. We now need to create a single list containing both sets of data, which the learning algorithm can use for training.

```
allPics={Thread[catpics->cat], Thread[dogpics->dog]}//Flatten
```

The curly braces mean that we’re creating a list – threading together the existing list of cat pics and assigning them all the entity “cat”. We’re then doing the same with dogs, and flattening it to force it to be a single, one-dimensional, list of name/image pairs.

With all this done, we need to feed this list into Mathematica’s classification engine:

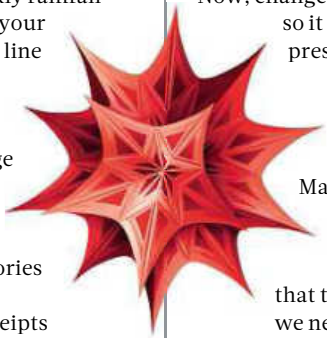
```
DogOrCat=Classify[allPics]
```

Once this is done, you’ll have your own image-processing function ready for action. The final step is to feed in a picture and see whether your function can tell whether it’s canine or feline. I found an image of a Rottweiler online, downloaded it to my desktop and fed it into our function:

```
DogOrCat[Import["/home/pi/Desktop/rott.jpg"]]
```

My function correctly identified it as a dog and worked with most of the other photos I tried – although it was stumped by a Westie.

This sort of machine learning function becomes more accurate with a larger dataset, but the limited memory of the Pi restricted the number of images we could use. You could reduce its memory footprint by using the image processing features, but make sure that your processing doesn’t reduce the usefulness of the images. ●



Apple 27in iMac with Retina 5K display

Warning: destroy all credit cards before reading this review.
The new 27in iMac is very close to perfection in a metal shell



SCORE ★★★★★

PRICE £1,333 (£1,599 inc VAT)
from apple.com/uk

No two ways about it, the iMac's Retina 5K display has plenty of pixels. To be precise, the 5,120 x 2,880 resolution means there are 14.7 million of the things. Enough that, if you counted every single one, at a rate of one per second, it would take you 170 days non-stop.

Turn the display off and it looks identical to previous 27in iMacs, because the physical design hasn't changed a jot since 2014 – and that's because it's already ridiculously good looking. It's Derek Zoolander's "Blue Steel" hewn from metal, glass and

Jony Ive's tears. It's dramatically sleeker and more attractive than any 27in monitor I've had on my desk in the past ten years, and yet somehow Apple has managed to pack in a fully functioning computer too. If we lived in the 14th century, Jony Ive would have been burned as a witch. My sole gripe with the iMac is that there's no height adjustability – you can only tilt the iMac back and forth.

What this isn't, however, is the most revolutionary iMac upgrade. Since last year's model was the first to debut the 5K Retina display, this late-2015 iMac is all about incremental improvements – think of it rather like the iPhone 6s and iPhone 6s Plus, in that most of the improvements are invisible to the naked eye.

■ Image quality

First things first – the Retina display on last year's model was already superb. There are still very few 5K monitors that you can go out and buy right this minute, and the ones that are available all cost well over £1,000. Not to be outdone, though, Apple has given this iMac a new 5K panel that reproduces a wider range of colour than before. In layman's terms, that means you can expect greener greens, bluer blues and pinker pinks than you've ever seen before. In professional parlance, you can expect to see 99% of the DCI-P3 colour gamut.

Forget about the geeky intricacies, though, and you can summarise the iMac's display like this: it's bright and insanely crisp, and whether you're dabbling in Photoshop, Final Cut Pro

or just shooting everything in sight in BioShock Infinite, it looks stupendous. Black is really very black; white is very, very white. For most people, it's the pinnacle of display performance – but there are caveats.

It all comes down to numbers. Our X-Rite iDisplay Pro colorimeter is a harsh mistress, capable of revealing the shortcomings that all but the best-trained eyes would struggle to see, but the Retina display puts up quite the fight. For instance, brightness reaches right up to a slightly silly 466cd/m² – that's the kind of figure I'd expect from a top-notch TV, not a desktop monitor – and contrast hits a ratio of 1,166:1, which is very good indeed.

Colour accuracy is much improved on last year's model, too. While the 2014 iMac achieved a Delta E of 1.8, this year sees that figure drop to 0.7. Flick between the iMac's various preinstalled colour modes – sRGB, Adobe RGB, DCI-P3 – and you can expect a finely honed, colour-accurate performance whatever application you're working in. The panel whips up 99.9% of the sRGB gamut, 86.1% of the Adobe RGB gamut and every corner of the DCI-P3 gamut, bar the most intense shades of blue and cyan.

So what's the downside? Well, if you're a professional for whom only the very best will do, then the iMac's backlighting still isn't up to the standards of pro-level monitors. While the backlighting of money-no-object displays is designed to be consistent from corner to corner, deviating by as little as a few percent, the iMac is less rigorous – for the particular model I tested, it was between 10% and 16% dimmer in the bottom-left corner, and around 10% dimmer in the right. If you absolutely need a display that is consistent across the whole panel, then this isn't it, but you'll need flawless vision – and some serious experience – to notice the problems in the first place.

Performance

Should you be inquisitive enough to rip open the iMac, then you'd find a completely revamped set of innards. Inside, quad-core Intel Skylake processors make their debut,

alongside AMD's new series of graphics chips. Going by our benchmarks, the combination delivers a healthy kick in applications and reasonable 3D performance.

The 3.2GHz Intel Core i5-6500 in our review model – which is the slowest processor available in the new line-up – proved almost 10% faster than the 3.5GHz Core i5 in last year's iMac, which is a pretty impressive increase. Would you notice the difference in everyday use? Probably not. A few seconds here and there in Photoshop maybe, a slightly speedier, snappier overall feel – nothing worth fretting about if you already own last year's model.

In fact, one of my few disappointments with this year's 27in iMac is that the new AMD chip doesn't quite hold up its end of the bargain. Depending on which model you go for, you'll get the new R9 M380, R9 M390 or R9 M395X, but these aren't fundamentally superior to last year's graphics chips. The speeds of the GPU core and memory have increased a tad, and there are a few subtle tweaks, but these new GPUs are really little more than a rebrand of last year's R9 M280X, R9 M290X and R9 M295X. Regardless of how much money you spend, don't expect to be playing the latest titles in 5K. In fact, you'll struggle to play demanding titles at half the iMac's 5K resolution – try cranking *The Witcher 3* to maximum details and you'll be watching a very pretty

RIGHT Physically this year's 27in iMac looks no different to last year's – and that's no bad thing

ABOVE The 5K display is a thing of beauty, and able to reach "silly" brightness levels of 466cd/m²

slideshow. Like it or not, it's going to be several years before the iMac delivers dreamily smooth 5K gaming.

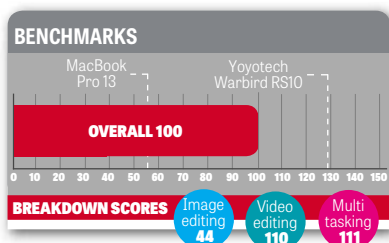
For instance, Unigine's Heaven benchmark is a good representation of how much gaming grunt a machine has – it's all graphical whizz-bang and super-detailed textures (also: dragons) – and it shows exactly how limited the iMac's GPU power is. At 2,560 x 1,440 resolution and Medium detail, the R9 M390 in our review unit managed a reasonable but still slightly stuttery 26fps. This means that, in most cases, you'll just have to put up with gaming in Full HD resolutions if you want super-smooth frame rates. Of those 14.7 million pixels I mentioned earlier, it turns out around 12 million are surplus to requirements, for gaming at least.

The iMac's 1TB Fusion Drive is a much more worthy inclusion. Sadly, it's not nuclear-powered – this would be simultaneously both worrying and impressive – but it does combine a superfast 24GB SSD with a 1TB hard disk. The theory is that all your regularly used applications and data end up on the SSD, and everything else gets plonked onto the HDD. Does this work? Well, probably. The iMac is very quick in benchmarks, but it's difficult to say how well the system will work once you've filled the storage with the accumulated gunk of several years' use. Out of the box, it's obscenely fast – I clocked it at around 687MB/sec while reading files, and 170MB/sec while writing them back to the disk.

That's quick, but nowhere near as lightning-fast as the pure flash storage in my 13in MacBook Pro. If you have more cash, then you can always swap the Fusion Drive for proper full-fat flash storage in the iMac – the only problem is that you'll need to add another £700 or so if you want 1TB. Oh, and don't, whatever you do, be tempted to save cash and go for the cheapest 5K iMac – that has a bog-standard 1TB hard drive in it. You'll be cursing your decision in no time. Don't do it.

Accessories

This year Apple has upgraded every single one of the iMac's so-called Magic accessories. The keyboard has lost its chunky AA batteries in favour of an internal lithium-ion battery that's charged by dreams and wonder. Well, a Lightning cable. In fact, this goes for all the new Magic devices – Lightning cables all round. One-month



battery life between charges. Neat little physical on/off switches on the rear. It's all very clever.

The Magic Trackpad 2 is far more awesome than it looks. It has the air of a Philippe Starck-designed door wedge, and at £109 on its own, it costs about the same too. At the time of iMac purchase, you can swap it for the mouse for an extra £44.

The new Trackpad is 30% larger than previously, but the big news is Force Touch. Powered off, it's a large slab of cold, unclicky frosted glass; flick the switch and it provides all the handy Force Touch functionality and gesture-controlled loveliness that I've come to expect from my MacBook Pro. Touchpads on a desktop might sound like a rubbish idea, but Apple really makes it work – flicking between multiple desktops and whizzing up Mission Control is fast and instinctive. Plug it in, use it, and – trust me – you'll miss it when it's gone.

But the truly magical feature is Silent Clicking. Enable this in the control panel and the high-pitched click disappears, leaving only the low-frequency thump to be felt through your fingertip. For those that value silence above all else, it's a great party trick.

It's harder to get excited about the Magic Keyboard 2. It's much flatter than before, due entirely to the removal of those AA batteries at the rear, so depending on how you like your keyboard to be angled, this may not be your bag at all.

If you can get used to this – and despite being no bigger than the keyboards on Apple's MacBook Pro laptops – the Keyboard 2 is very nice to type on. The function keys along the top are now all full-sized, and the left and right cursor keys have grown too. Apple has also changed the design of the keys, and they click and bounce in all the right ways. It's much smaller than traditional desktop keyboards, though, so I suspect some people will hate it from the start. Given the choice, I'd probably reach for an ugly old Microsoft keyboard. But you do get one of these new keyboards free with the iMac.

Then there's the Magic Mouse 2. What's magical this time? Well, it's a mouse. It's wireless. It moves cursors all day, every day. It's comfy to use, and although there still aren't discrete left and right buttons, it works so predictably that there may as well be. And, as with all the new Magic accessories, it charges via a Lightning



cable. It's bundled with the iMac for free, or you can go out and buy one for £65. It really isn't desperately exciting. And if you do like games, it's not the greatest choice – a cheaper USB gaming mouse would make a much better bet.

Connectivity

As always, the iMac's ports are hidden awkwardly around the right-hand rear of the iMac; if you're the type of person who plugs in drives and peripherals, I recommend the immediate purchase of a USB hub. On the plus side, when it comes to connections there's everything you could hope for: four USB 3 ports, two Thunderbolt 2, Gigabit Ethernet and an SD card reader. And a headphone output that doubles as an optical digital audio out. Factor in the dual-band 802.11ac and Bluetooth 4 wireless networking and the iMac hits all the right notes. You can even whip off a panel at the rear and add more RAM. There are four slots, two occupied as standard, and you can have up to 32GB installed in total. It's a refreshingly easy upgrade path.

Verdict

The short verdict is easy: the Apple 27in iMac with Retina 5K display is great. The best all-in-one computer around, and by a furlong.

My only bugbear – aside from the non-adjustable stand – is the lack of really powerful graphics. If I had the choice, I'd want one of Nvidia's GeForce GTX 980 chips in here – it is possible to get desktop-class Nvidia graphics in a 17in laptop, so I'd expect Apple to be able to do the same. If I have a 5K screen, I want to play the latest games at 2,560 x 1,440 resolution at a bare minimum.

Let that slide, though – after all, you may not care

ABOVE The new Magic Keyboard and Mouse are even more magical than before, thanks to being wireless – simply charge over Lightning

“The Apple 27in iMac with Retina 5K display is the best all-in-one computer around, and by a furlong”

BELOW The iMac's rear is as minimal as ever, but does include two Thunderbolt 2 and four USB 3 ports



about gaming – and the only other question is which model to buy. This is an easy question: as long as you don't buy the cheapest £1,449 iMac

(the one with the limiting 1TB hard drive), then I suspect you'll be very happy indeed.

Unless performance is vital to you, it's very questionable whether it's worth spending the extra £200 for a Core i7 CPU. I'd also be interested to see what difference the range-topping AMD Radeon R9 M395X GPU would make to performance. But as that upgrade bumps the price up to £2,049, I'm not sure I'd want to spend the extra to find out.

It's impossible to describe any computer that costs £1,599 as cheap, but the mid-point of the new 27in iMac line-up really is very good value for money. A display of this quality

would cost at least £1,000 on its own, maybe more; it wouldn't look anywhere near as pretty; and it wouldn't come with a fast, capable, fully functioning computer. Sure, you could

build a faster desktop PC and make do with a 4K monitor, but this is besides the point. As all-in-one PCs go, the 27in iMac is something of a steal. **SASHA MULLER**

SPECIFICATIONS

Quad-core 3.1GHz Intel Core i5 processor • AMD Radeon R9 M390 graphics with 2GB GDDR5 memory • 8GB RAM • 1TB Fusion Drive • 27in 5,120 x 2,880 Retina 5K IPS display • SDXC card slot • 4 x USB 3 • 2 x Thunderbolt 2 • Gigabit Ethernet • 802.11ac Wi-Fi • Bluetooth 4 • FaceTime HD camera • OS X El Capitan • 1yr RTB warranty • 650 x 203 x 516mm (WDH) • 9.5kg



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Sony Xperia Z5

Fast, gorgeous and long-lasting, the Xperia Z5 mixes with the best smartphones in the business

SCORE ★★★★★

PRICE SIM-free, 32GB, £458 (£550 inc VAT) from expansys.com

Sony's flagship Xperia range of smartphones has undergone a rapid evolution over the past year or two, with the Z2, Z3 and Z3+ all appearing within 18 months of each other. With such small intervals between each revamp, though, the changes made to the phones weren't particularly groundbreaking.

With the Z5, however, that all changes. It introduces a refined design, a revamped camera and a fingerprint reader. The end result is a far superior phone.

Design

At first glance, the Xperia Z5 isn't all that different from its forebears. It keeps the trademark glass-slabbed front and back, and the phone is both water- and dust-resistant.

Sony has provided a few subtle alterations with this generation, adding an engraved Xperia logo on the left edge, squaring off the phone's metal frame slightly, and swapping the glossy glass rear for frosted glass. The edge of the phone is slightly raised this time, which prevents it slipping off inclined surfaces quite as easily as the Z3, and in each of the white, black, gold and green colour options, it looks simply gorgeous.

The biggest design departure is the look of the power button. Sony's trademark silver circle is replaced by an elongated lozenge, slightly inset from the edge to prevent you from accidentally pressing it. This seems a frivolous change on the surface, but there's more substance to it than first meets the eye, because the button hides one of the Z5's big new features: a fingerprint reader.

Most smartphones with one of these components have opted to pop it beneath the home button, which is awkward to reach on a handset this large. With the Sony Z5, you pick it up, depress the power button and you're good to go. It works both reliably and quickly, whatever the orientation of your digits, and is the best implemented fingerprint reader I've seen.



Cameras

The other big change for the Z5 is the camera, which sees its first hardware upgrade since the advent of the Xperia Z1 in September 2013.

The new Exmor RS rear camera module bumps up the maximum resolution to 23 megapixels, the sensor size to 1/2.3in, and also incorporates SteadyShot optical image stabilisation (OIS), plus hybrid autofocus, by adding phase-detect pixels to the image sensor.

Unsurprisingly, Sony claims its autofocus system is the fastest in the business, capable of focusing on your subject in as little as 0.03 seconds. It's certainly quick, but it does hunt a touch, especially in low light. When you use the camera shutter, you're never quite sure if it's locked on or not. This cancels out the superfast autofocus somewhat, and leads to the odd out-of-focus shot.

In a more tangible win over the opposition, Sony's sensor has its phase-detect sensors scattered all

over the sensor, even in the corners, which means you can tap anywhere on the screen to focus. I found this was the most reliable way of setting focus on the Z5, and when I used it this way, it felt far more surefooted.

The rear camera has an f/2 aperture, which matches that of the Samsung Galaxy S6 and lags very slightly behind the LG G4's f/1.9. It can shoot 4K video, and Sony has also given its digital Clear Image Zoom facility a boost, allowing you to zoom into a scene digitally by a factor of five.

What does this mean for outright quality, though? In my testing, an awful lot. In short, Sony has brought its smartphone camera bang up to date, and it's now almost as good as the best in the business. That's no mean feat when you consider how good the Samsung Galaxy S6's camera is.

Despite the increased resolution and new optical image stabilisation, what really impressed me about the new camera was how reliable the auto-exposure proved to be. It coped with every scene I threw at the Z5's camera beautifully, capturing photos packed with contrast, detail and balanced colours.

Where the Xperia Z5 isn't so good is in low light. Dip the lights and turn off the duo-tone LED flash, and it struggles to keep up with either the Galaxy S6 or the iPhone 6s and 6s Plus, with noise and artefacts joining forces to smooch out detail and stomp all over subtlety.

It's rescued somewhat by its excellent video stabilisation. This all but eliminates the jelly-shake you see in most rival smartphones' video modes, even when you're walking down the street. Despite that function, I'd still place the Z5

a fraction behind the other leading lights overall.

As for the front-facing camera, that's also seen a big boost in resolution, from 2.2 megapixels in the Xperia Z3 to 5 megapixels here. It delivers selfies

with detail, but there's no front-facing flash.

Performance

The fingerprint reader and camera represent big enough improvements to warrant an upgrade from any of the previous Z-series smartphones, so it is no particular surprise to discover that the rest of the Sony Xperia Z5's specifications and features represent a much milder improvement.

Beneath the surface is a Qualcomm Snapdragon 810 v2.1 chipset with an Adreno 430 graphics chip and a healthy 3GB of RAM. There's 32GB

ABOVE The Xperia Z5 represents Sony's biggest ever upgrade to its phones

"The fingerprint reader and camera represent big enough improvements to warrant an upgrade from any Z-series smartphone"

BELOW The power button now features a fingerprint reader, so unlocking the phone is very simple

of storage available, plus a microSD slot for expansion. This draws the Z5 level with the LG G4 in terms of overall flexibility, even if the battery isn't user-replaceable.

In real terms, the Z5 feels powerful and slick. Homepage transitions are smooth, as is scrolling and panning in web pages and Google Maps, and I noticed no multitasking slowdown or dropping of frames while playing demanding games.

In the benchmarks, the Sony Xperia Z5 performed exactly as I'd expect a phone equipped with a top-end Qualcomm chip to. In both the GFXBench gaming tests and the Geekbench CPU tests, it was faster than almost any other smartphone I've tested – the exceptions being the Samsung S6 family and Apple's iPhone 6s and 6s Plus.

The Z5 can get warm when you're playing games, but Sony seems to have tamed the worst excesses of the Qualcomm chip here. After a few minutes of running the GFXBench Manhattan gaming test, the rear of the phone around the camera reached a temperature of 38°C. This might give you sweaty palms, but isn't particularly uncomfortable in normal use.

As for audio, the front-facing speakers reach reasonable volumes and don't distort while they're doing so, and I found call quality to be fine – clear and distortion-free at both ends of the line. For connectivity, the Z5 runs the full gamut, including support for 4G, 802.11ac Wi-Fi and near-field communication (NFC).

Battery life

The Z5 is equipped with a 2,900mAh battery, which Sony claims delivers up to two days of stamina. In general use, I'd say that's achievable if all you do is browse the web, check your messages and listen to the odd podcast. Sony's battery-management schemes are pretty good, and contribute to excellent stamina in moderate use.

However, if you do any gaming, audio streaming or watch videos, you will be looking at battery life of closer to a day. A comfortable day, with 20% to 30% of battery capacity remaining at bedtime, but a single day nonetheless.

Test results back up that subjective experience. In video playback, the phone used up its capacity at 7.5% per hour (in Flight mode), and while streaming audio over 4G, it fell at a rate of 4.1% per hour. In terms of the flagship phones I've reviewed this year, those results place it slightly behind the best around – the Samsung Galaxy S6 and S6

Edge, the iPhone 6s and 6s Plus, and the LG G4.

Still, the Z5 has support for fast charging, and will give you a claimed 5hrs 30mins of battery life from ten minutes plugged into the mains. Alas – rather infuriatingly – Sony doesn't include a charger in the box.

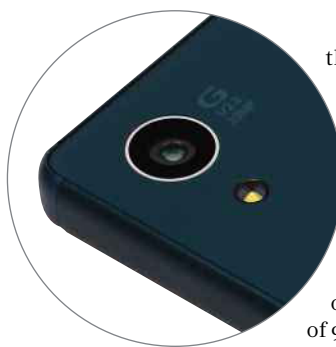
Display

The display hasn't seen an obvious upgrade. Despite the fact that Sony is lavishing a 4K screen on the larger Z5 Premium, the Z5 remains lumbered with a bog-standard 1,080 x 1,920 resolution IPS display, topped with unbranded tempered glass.

I say lumbered, but this apparently "low" resolution shouldn't put off potential purchasers. Despite the loud protestations of smartphone manufacturers, a 1080p screen on a 5.2in screen diagonal is sharp enough that most people won't be able to discern the pixels from normal viewing distances.

More importantly, the quality is excellent, particularly when it comes to brightness. Push the Xperia Z5 up to its maximum level (with adaptive brightness turned off) and it reaches eye-searing levels that make it readable in the sunniest of conditions. Despite the fact that the phone uses a standard IPS panel, Sony's X-Reality adaptations mean that colours really leap out at you. The overall effect is similar to the super-saturated colours you get on Samsung's Super AMOLED screens.

If you prefer your colours more muted, you can always turn X-Reality off. When disabled,



ABOVE Sony's updated camera is almost the best around

the display stacks up pretty well. Under testing, using an X-Rite i1 Display Pro, the screen proved to be among the brightest I've ever seen, reaching a maximum of 684cd/m² (with adaptive brightness disabled), and delivering a contrast ratio of 1,078:1 and sRGB coverage of 99.4%.

When it comes to outright quality, the Sony Xperia Z5's screen can't quite match the raw immediacy of Samsung's Super AMOLED displays, or the contrast ratio and solidity of the screens on Apple's latest phones, but it's the match of anything else on the market right now.

Software

Sony's software lives on top of Android 5.1.1 and, unlike some, isn't that overbearing. Indeed, the changes

to the app drawer allow you to sort and manage items in any way you like, and are actually pretty handy.

Otherwise, the additions are limited to a few extra apps and

icon changes, plus Sony's power-management facilities, which will eke out extra battery life in desperate times.

Verdict

It's good to see Sony lavishing some upgrades worthy of the name on its flagship phone. With an impressive new camera module, a fingerprint reader and refined design, it's a highly competent handset that, for fans of previous Sony phones, raises the bar significantly over the Xperia Z3 and Z3+.

The issue for the Z5 is that, while it's very good, it's still slightly behind its rivals in some areas. For example, its camera, screen and battery life are all excellent, but the Samsung Galaxy S6 and iPhone 6s are superior across the board, while the LG G4 offers more flexibility and an equally strong package for less money.

If you like the combination of weatherproofing and the microSD slot, then this is definitely the phone for you. However, for me, it's not quite the match of its rivals. **JONATHAN BRAY**

SPECIFICATIONS

Octa-core 2GHz Qualcomm Snapdragon 810 SoC • 3GB RAM • 32GB storage • microSD slot (up to 200GB) • 5.2in 1,080 x 1,920 IPS display • 23/5.1MP rear/front cameras • 802.11ac Wi-Fi • 4G • 2,900mAh Li-ion battery • Android 5.1.1 (Lollipop) • 1yr RTB warranty • 73 x 7.3 x 146mm (WDH) • 154g

"The Xperia Z5 has support for fast charging, and will give you 5hrs 30mins of battery from ten minutes plugged into the mains"

BELOW Need to give your phone a rinse? Luckily the Xperia Z5 is water-resistant





Nexus 5X

It's an ugly duckling of a phone, but the rest is sheer brilliance. The Nexus series is back with a bang

SCORE ★★★★★

PRICE 16GB, £283 (£339 inc VAT)
from store.google.com

The Nexus 5X is at the vanguard of a new wave of smartphones. First established by Google with the hugely popular Nexus 5, and followed by phones such as the OnePlus One, this new breed sits neatly between the low-cost Moto G on one side and flagships such as the iPhone 6s on the other.

It's an attempt to offer the best of both – a smartphone with everything you need, but with none of the bells and whistles you don't. That, in short, is precisely what Google's Nexus 5X delivers.

■ No supermodel curves

Given the £339 price, it isn't a shock that the Nexus 5X is no supermodel. Available in black, white and light blue, it has a smooth, eggshell finish to its coloured plastic back, complete with clumsy branding for LG, which made this iteration of the Nexus.

In terms of shape, the 5X moves away from the Nexus 6's curved case and chiselled edges, instead preferring a flat rear panel with only short radius curves at the sides. It's a more practical design than the Nexus 6 – you can place the phone on a table and tap away without it wobbling – but it's far less attractive.

More seriously, perhaps, the cheap feel also extends to the mechanical aspects of the design. The 5X's power and volume rocker on the right edge feel plasticky and insubstantial. The nano-SIM drawer doesn't close with a positive click. Overall, it's a far cry from the Nexus 6. The only advantage the Nexus 5X holds from a physical perspective is that it's extremely light for a phone of its size, weighing a mere 136g, and is comfortable to hold and slide into a pocket.

The front is less of a design disaster, mainly because it's pretty featureless. Flanking the 5.2in screen, top and bottom, are a pair of stereo speakers, which is a design decision carried over from the Nexus 6 and one I very much approve of. I'm tired of having to be careful how I hold a phone such as the iPhone 6s for fear of blocking the grille and muting the audio.

As for the screen itself – well, it's unremarkable. With 1,080 x 1,920 pixels, it offers a high 423ppi pixel density, and it's also bright. The problem is that it lacks the vivid punch of the best phones.

■ The latest tech

One thing this phone delivers, without dispute, is all the latest in smartphone technology. There are two aspects of this you'll notice right away. First, the Nexus 5X has a USB Type-C socket, a new type of charging and data-transfer port, located on the bottom edge of the phone. Second, it has a fingerprint reader, which sits on the rear of the phone, just below the slightly protruding camera housing.

From a design perspective, the decision on Google's part to implement both technologies is to be applauded. I much prefer Type-C's physical design to the ubiquitous micro-USB. It's reversible, so can't be forced in the wrong way, and it engages with a more positive click than most micro-USB ports. You will need to budget for spare cables,

though, and purchase an adapter straight away if you want to plug it into a laptop or car charger. Bizarrely, the cable in the box is a double-ended Type-C cable, which can't be connected to modern chargers and computers.

The fingerprint reader (dubbed Nexus Imprint) works beautifully, allowing you to access and purchase Google Play content quickly and simply, without having to type in a password. Its position on the rear means it falls naturally under your index finger as you pick up the phone. It's quick and easy to register your fingerprints, and – so Google claims – it will also learn and become more accurate as you use it.

Frankly, I'm not sure it needs to. The only time the Nexus 5X failed to recognise my fingerprint was when I placed my finger half-on the sensor. On every other occasion, it worked flawlessly and quickly. It's roughly on a par with the iPhone 6s' Touch ID sensor in terms of how quickly you can unlock the phone.

Given all this cutting-edge technology, it's disappointing that Google continues to omit one of the more humdrum elements – expandable storage – from its Nexus handsets. Once you've bought your 16GB or 32GB Nexus 5X, you'll be stuck with it, so choose carefully.

■ Speed and battery life

Instead of going all out for the most powerful mobile chip on the market, which has been left for the flagship Nexus 6P, the Nexus 5X contains a hexa-core 2GHz Qualcomm Snapdragon 808 processor. That's the same as is found within the LG G4, and Google accompanies it with 2GB of RAM and an Adreno 418 GPU.

In benchmarks, this means the Nexus 5X doesn't hit the heights of the most expensive phones on the market. But it will be more than fast enough for most people. My only complaint is that the camera app is occasionally a little sluggish to launch, and stutters when you swipe



ABOVE We're not fans of the Nexus 5X's looks, but it's what's inside that counts



from stills to video mode and back again.

One bonus of the slightly lower-specification processor is that the 5X avoids the overheating issues that has afflicted some phones featuring the faster Snapdragon 810 CPU. Sure, it gets warm when you fire up a demanding game such as Dustoff Heli Rescue, but it never becomes uncomfortable to hold.

There's no payback in battery life, however. With moderate use – that is to say, not pounding the battery constantly with games and streaming over 4G – you'll get a day out of it, and nothing more. This is a phone you'll need to charge every evening.

The positive news is that those users moving up from a Nexus 5 will experience significantly better battery life, and it's also worth noting that the 5X charges supremely quickly. In my tests, it hit 20% charge in the first ten minutes, which is impressive. After half an hour, the level of charge rose to 48%, an hour saw it reach 84% and the phone was fully topped up in only 1hr 40mins.

■ Cameras

The area that let down the past two Nexus smartphones was the quality of their cameras, but not this time. The new camera is an absolute beast.

It matches the iPhone 6s for resolution, and its sensor beats it for size. Each of the Nexus 5X's pixels are 1.55µm (microns) in size (the 6s' pixels are 1.22µm), allowing them to capture more light at a given shutter speed.

The aperture is a wide f/2, and it can shoot 4K video and slow-motion 720p footage at 120fps. It's equipped with "laser-detect" autofocus, and it has optical image stabilisation (OIS). The hardware, however, is only part of the story. If the software isn't good enough to set the focus, exposure, white balance and ISO sensitivity at the correct level, you'll get horrible pictures, no matter how potent the optics and sensor.

The good news is that the software and hardware on the Nexus 5X work perfectly in tandem, and the result is amazing photographs. The laser autofocus system locks onto subjects quickly and securely, with very little of the annoying hunting back and forth that plagued the Nexus 6. Moreover, the 5X's camera proved incredibly reliable in all conditions. In good light, low light and under the steel-grey sky of a typically rainy London day, the Nexus 5X produced photographs bursting with detail, realism and colour.

Even video capture is top-drawer, although I found that, despite the OIS function, handshake is readily transferred to footage. Be sure to stand still while recording home movies.

At the front is a more run-of-the-mill 5-megapixel snapper, equipped with an f/2.2 aperture, but with slightly smaller 1.4µm pixels. That said, you shouldn't underestimate it. It captures selfies with a scary level of detail, and its wide-angle lens makes group shots a doddle.

■ Verdict

If your priority is appearance, the Google Nexus 5X is not the phone for you. However, if you don't give a hoot about that – and, don't forget, you can always pop it in a case – the Nexus 5X is hugely appealing. The camera is simply stonking: it's fast and doesn't overheat. The software is also clean and simple, and Google and LG have squeezed in most of the components a modern smartphone needs – with the obvious exception

of storage expansion.

Its main rival – the OnePlus 2 – still offers more for your money, with a nicer design, even faster performance and fractionally better battery life for only £239.

However, the fact that you need an invitation to buy one rules the OnePlus 2 out as an option for most people. Furthermore, the camera isn't nearly as good as the Nexus 5X's and it doesn't have Android Marshmallow.

In short, the Nexus 5X is a serious option for your next smartphone. It certainly isn't a beauty, but Google and LG get almost everything else right. **JONATHAN BRAY**

"In good light, low light and under the steel-grey sky of a rainy London day, the 5X produced photos bursting with detail and colour"

SPECIFICATIONS

Hexa-core 1.8GHz Qualcomm Snapdragon 808 CPU ● Adreno 418 GPU ● 2GB RAM ● 16GB/32GB storage ● 5.2in 1,200 x 1,920 IPS display ● 12.3MP/5MP rear/front cameras ● 802.11ac Wi-Fi ● 4G ● 2,700mAh battery ● Android 6 ● 1yr RTB warranty ● 72.6 x 7.9 x 147mm (WDH) ● 136g

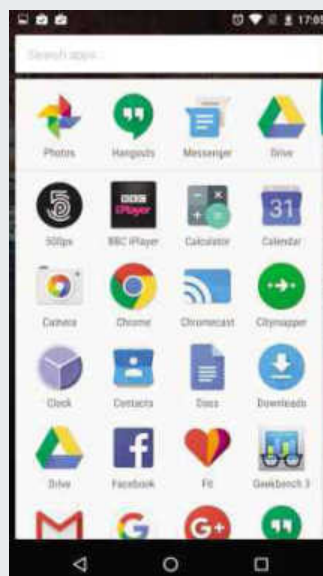
Android 6 Marshmallow

As always, the new Nexus comes with the latest version of Android out of the box, and this year it's the turn of Android 6 Marshmallow. It's also guaranteed – for the next two years – to get the next version of Android before any non-Nexus phone.

You should be pretty pleased with the current version, though. I've been using Marshmallow on a Nexus 6 for some time now and it's excellent, building on the visual overhaul introduced last year with a host of subtle improvements.

The most obvious change from a visual perspective is the redesigned app drawer. This changes from horizontal sliding pages to a vertically scrolling list of apps sorted by their initial letter, and introduces a search box and a quick list of shortcuts to recently used apps at the top.

The next big upgrade is Google's new "Now on Tap" feature, which offers contextual search and suggestions based on what's displayed onscreen. It works

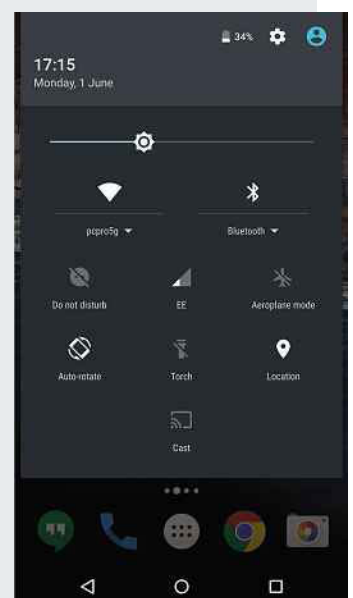


anywhere, whether you're in an app, browsing a website or conversing with a friend over SMS or WhatsApp. All you do is hold the home button down for a second or two, the software grabs what's onscreen, sends it up to the servers and Google returns a few seconds later with a panel of results on a pop-up layer at the bottom of the screen.

It's clever stuff: texting my colleague Sasha Muller about craft beer generated a useful link to the Beavertown Brewery website, as well as a map, phone number and Street View images.

I'm not convinced this will change my life, but I can definitely see the value of the new Doze mode. This is designed to help extend battery life by putting the phone into sleep mode when you leave it on a surface for an extended period of time – on your bedside table, for instance.

There's a handful of other nice touches, too. I particularly like the indicator on the lockscreen that shows whether you're in quick-charge mode or not, and Google has streamlined the number of preinstalled apps. It adds up to the slickest version of Android yet.



Yoyotech Warbird RS10

A fast and flashy PC aimed at gamers, but whisper-quiet running ensures it has much wider appeal

SCORE ★★★★★

PRICE £500 (£600 inc VAT) from yoyotech.co.uk

This is not a PC for shrinking violets. It's big, bolshy and about 50 times more bling than we're used to seeing in the refined pages of *PC Pro*. I'm not even referring to the neon blue 120mm fan on the side and the red backlighting of the MSI motherboard: even the twin sticks of 4GB DDR4 RAM light up.

It doesn't take Sherlock Holmes to detect that this is a PC for gamers. Especially since a glance through the case window highlights the MSI GTX 960 lettering on the chunky graphics card. Despite its size, the GTX 960 sits in the middle of Nvidia's GPUs range, and is best partnered with screens up to 1,920 x 1,080 resolution – it will struggle to play action-packed games at any higher resolution than that.

Stick to this resolution, though, and you'll have little cause for complaint. For instance, *Dirt Showdown* returned frame rates of 82.3fps at Ultra quality with 4x anti-aliasing, while *Tomb Raider* delivered over 50fps with 2x super-sampling anti-aliasing and Ultra quality. It's only when you play more demanding games, such as *Metro* with super-sampling and anti-aliasing switched on, that things slow (to just under 30fps in this case).

The gaming theme extends to the motherboard, namely MSI's Z170A Gaming Pro. Aside from its pulsing red lights, its gaming credentials include numerous features designed for overclockers. Two PCI Express x16 slots sit vacant, along with two available PCI Express x1 slots (one x1 slot is blocked by the double-height graphics card).



ABOVE The Warbird's case can hardly be described as modest

“With all of this power, you might expect the Warbird to be a screaming banshee. Not a bit of it: Yoyotech has selected quiet fans”

BELOW The Warbird is 50 times more bling than we're used to in the *PC Pro* office

Yoyotech ensures that there's enough power for some of these extras, courtesy of the Integrator 500W PSU. It neatly arranges the cables inside the case too, so when you decide it's time to add an optical drive – there isn't one included – or another hard disk, everything you need is there already. In total, three internal 3.5in bays sit empty, with three vacant external bays at the top: two 5.25in, one 3.5in.

Not that running out of storage should be an immediate concern, with 1TB available as things stand. Note this is a mechanical hard disk, so you might want to invest in an SSD at some point for a further boost but, even as it stands, this is one fast machine. Overall, it scored 128 in our benchmarks, which is 28% faster than our reference Intel Core i7-2600K PC.

With all of this power, you might expect the Warbird to be a screaming banshee. And you'd be wrong. Yoyotech has taken great care to select

quiet fans, and in general use you'll only hear a gentle, quiet hum.

That does change once you push the graphics card and CPU in games for a prolonged period, but by then you should be too busy fending off alien invaders to notice.

Even when I put it through its paces in our rendering and image-processing benchmarks, it barely raised a murmur. That's all the more impressive when you consider that the Intel processor, which has a stock rate of 3.5GHz, is overclocked to 4.4GHz. This isn't a dangerous level for the excellent Skylake i5-6600K processor, which, as the K suffix denotes, is unlocked for just such tweaks. Each chip will have its own limit, though, and the MSI motherboard makes it easy to boost if you want to see how high your particular processor will go.

The case itself looks imposing, especially from the front where Yoyotech's logo stares at you (and no, unlike Alienware, this one doesn't light up). The more interesting action is at the top, though. If you place this 480mm-tall tower on your floor, then you can easily access two USB 3 and two USB 2 ports, plus slots for SD and microSD cards. There's even a convenient rotary volume control to mirror the power button on the right. In general, the case looks and feels high-quality. The only bum notes are those buttons, which feel cheap by comparison.

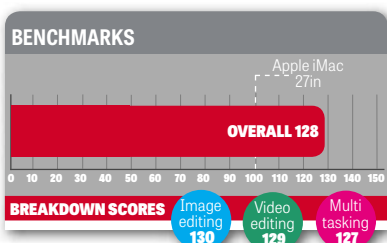
The rear backplate offers another eight USB slots, six of which are USB 3. There's no shortage of video outputs either, with the MSI card providing three DisplayLink

outputs, one DMI and a DVI-I port.

The price doesn't include a monitor, keyboard or mouse, but for an extra £100 inc VAT, Yoyotech is offering a bundle of a 22in Iiyama E2283HS-B1 monitor and a Zalman keyboard and mouse. With or without this bundle, you're getting a lot of hardware for the money. This is an excellent base on which to build, but enough to keep most people happy for several years. After a long run, it knocks the Chillblast Fusion Quasar off its A-List perch. **TIM DANTON**

SPECIFICATIONS

3.5GHz Intel Core i5-6600K overclocked to 4.4GHz • 8GB 2.4GHz DDR4 RAM (2 x 4GB) • 1TB Seagate ST1000DM003 hard disk • MSI GTX 960 2GD5 graphics card • WH-01 Gaming Black Midi Tower Case • 500W AeroCool Integrator 500W PSU • 1yr C&R warranty (parts & labour) plus 2yr RTB (labour-only) • Windows 10 Home



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Adobe Photoshop Elements 14

Still a fine photo editor, but why buy this when you can subscribe to Photoshop and Lightroom proper?

SCORE ★★★★★

PRICE £66 (£79 inc VAT); upgrade, £65 inc VAT from adobe.com/uk

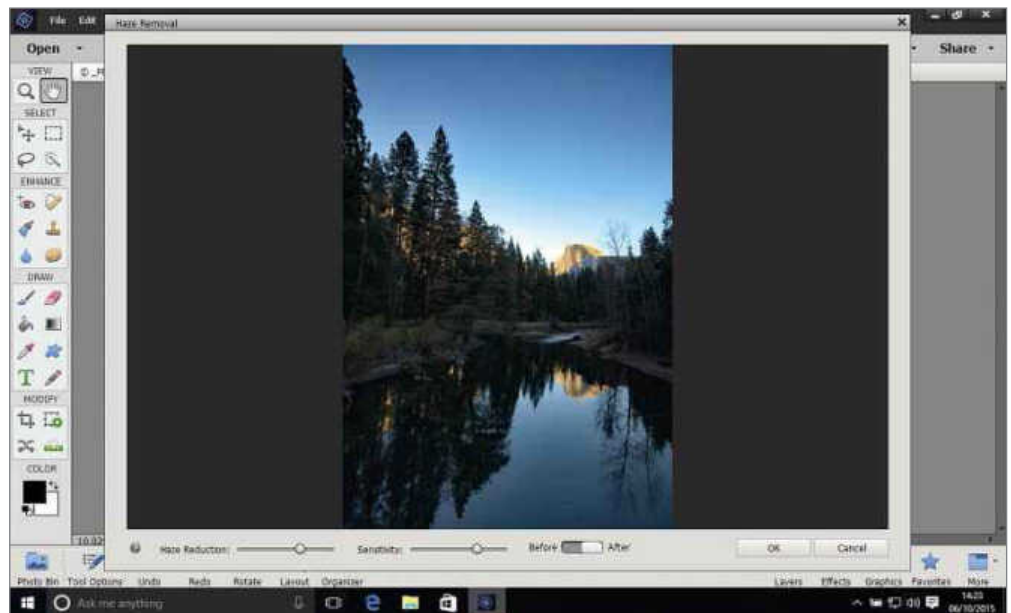
“It can’t go on like this.” So ended our preview of Photoshop Elements 14, having rounded up the sparse list of new features added over Elements 13. Adobe’s annual upgrade to its flagship editing application is so regular that you can set your watch by it, and our complaint is that Adobe manages to find fewer new features to add each year. With Adobe’s Photography Creative Cloud plan – which includes Lightroom and Photoshop proper – costing £103 per year, the argument for a less well-featured application gets weaker every autumn.

The slog through Elements’ new features begins with a few welcome additions. Dehaze, which offers to sort out atmospheric distortion in the background of landscape images, is a pleasing inclusion. It worked well in our tests, adding punch and clarity to areas of middling contrast, without ditching too much detail in shadow.

For twiddlers, there’s the option of a pop-up Dehaze screen with amount and sensitivity sliders, as well as a before-and-after toggle. However, I was generally unable to improve on the effect offered by the automatic tool. But landscape photographers, particularly those too lazy to set their alarm clocks to hit the good light, will love it.

Camera-shake reduction is another inclusion likely to appeal to beginners. The promise is that images taken with too much movement can be salvaged. I tried shake reduction on a series of blurred holiday selfies and was disappointed by the results, particularly compared to Adobe’s very optimistic marketing.

Shake reduction simply applies a very heavy-handed round of sharpening to an image, clearing up the blurred edges, but leaving a mosaic-textured mess



of artefacts in their place. Manually taking over gave a slightly more pleasing result, and it could be argued that an artefact-riddled shot is better than a blurred one, but photographers should get their shots right on the camera rather than rely on this.

Where Elements excels is in its ability to teach. A new eLive tab at the top of the application gives users a curated selection of YouTube videos, step-by-step guides and demos. These run the gamut from walkthroughs on effects for posters to guides on better photography. For those without a favoured selection of hints and tricks sites, it’s a great place to start.

The Guided Edits panel makes a return – a selection of tools allowing you to achieve effects such as tilt-shift style photos or sepia. New to Elements 14 is a Speed effect, which attempts to replicate rear curtain sync shots with laughable results. Still, Elements 14’s desire to educate photographers about new tools and workflows, rather than simply supplying a group of one-click effects, makes it a powerful learning tool for those daunted by Photoshop.

There are smaller improvements. Open the Organizer and Adobe claims

ABOVE The Dehaze feature adds punch and clarity to areas of middling contrast

“Elements 14’s desire to educate photographers about new tools and workflows makes it a powerful learning tool”

BELOW Organizer’s facial-recognition tool returned zero false positives, but took few risks

to have improved facial recognition: importing several hundred images of people produced zero false positives, but it did seem to be conservative, often asking us to confirm the identity of the same face in different groups.

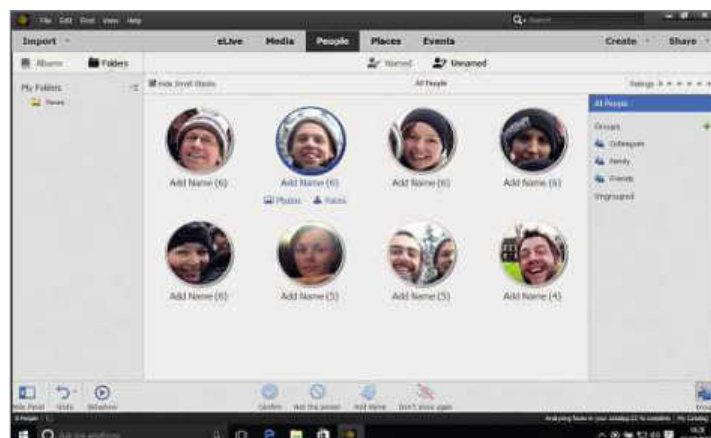
Adobe has also revamped the Places section of the Organizer, making it easier to define a location for images without such info in the EXIF data. It’s easily done: images lacking GPS co-ordinates are grouped

together by time, which means all your holiday snaps appear in roughly the same stack. Select them, search for a place on the right-hand map, and you’ll be asked if you want to define a location

for the photos.

But is there enough here to get new users or upgraders excited? The Guided Edits are a nice feature for beginners, but arguably nothing that you couldn’t find on YouTube. Similarly, Dehaze is a good tool, but it’s one that also features in both Photoshop proper and Lightroom CC. And if you have a previous version of Elements, the upgrade price of £65 is deeply unappealing for the relatively sparse selection of new features: the Dehaze tool and smattering of new Organizer features are decent, but not worth the money.

If you don’t have a previous version of Elements, the £80 price is too close to the £103 asked for subscribing to Photoshop and Lightroom for a year, both of which have superior features. Elements is, undeniably, a “proper”, per-pixel photo editor: if you’re on a tight budget and want layers, a clone brush and masking, it’s better than anything else on the market at this price. I just wish that was as exciting as it sounds. **DAVE STEVENSON**



Adobe Premiere Elements 14

A weak update, but it builds on strong foundations and the long overdue export overhaul is welcome

SCORE ★★★★★

PRICE £66 (£79 inc VAT); upgrade, £54 (£65 inc VAT) from adobe.com/uk

You know the bar has been set low for a software upgrade when two of the most lauded “features” merely help you discover what was there already. In this case, I’m talking about the Guided Edits. The first is Color Pop, which shows you where to find the Red Noir effect (this converts footage to monochrome while maintaining saturated reds). The tutorial then reveals how to adjust settings using the HSL Tuner filter to isolate a different colour.

The other new Guided Edit shows how to use the Time Remapping tool to create variable slow- and fast-motion effects. It’s a great feature, but not particularly hard to figure out without assistance.

That said, I do really like the new Guided Edits in Premiere Elements. While Photoshop Elements’ similarly named feature presents advanced functions with simplified controls, Premiere Elements’ implementation just points to the controls required to achieve various functions. This makes it much easier to go off on a different tangent, and apply the skills to other parts of the application. However, the disappointing thing is that they’re trickling out at a rate of two per year.

Audio View is another new, largely cosmetic, feature. It reveals buttons on each audio track for recording a narration and for soloing the track but, surprisingly, there’s no mute button. A master-level meter and fader help you avoid distorting the audio output, but there’s no fader for individual channels. Instead, levels are set per audio clip. When in Audio View mode, the Tools, Transitions and Effects buttons in the Action Bar show audio-related functions by default, but all this amounts to is an interface tweak and little more.

The new animated titles are a lot more substantial. There are 32 preset templates to choose from, organised by genres such as Sports, Travel and Wedding. They’re unusually elegant for consumer-orientated software, with simple illustrative graphics



that shimmy into view, along with a few lines of editable text.

The trouble with the elaborate templates is that it’s trickier to give the user free reign to customise them. The total length of these animated titles is fixed, and inserting longer words than the template allows can cause them to overlap. Text can be resized, reformatted and moved around, but it’s awkward. The presets are downloaded on demand, but I found this slow, even over our fast connection – 4MB downloads consistently took over a minute.

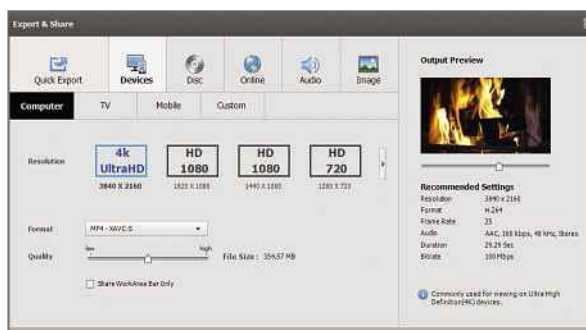
Another key new feature is 4K support. I had no problems importing 4K footage from a variety of sources, but preview performance was poor on my Core i7-3517U laptop. Sony Movie Studio Platinum was no better when handling 4K footage directly, but it does offer proxy editing – where temporary 720p copies of footage are generated to speed up the preview performance.

A long-running complaint of mine is how tricky it is to maintain consistent frame rates and resolutions from import to export. This has been much improved in version 14, with a revamped Export dialog box that automatically matches the frame rate to the source footage and offers various popular resolutions such as Ultra HD 4K (in XAVC S format), 1080p and 720p.

ABOVE It’s never been easier to add stylish animated titles to your videos

“The trouble with the more elaborate templates is that it’s trickier to give the user free reign to customise them”

BELOW Support for 4K is one of the headline new features in Elements 14



Meanwhile, the Advanced Settings panel gives options to adjust export settings manually, including detailed control over compression and the ability to save user presets. There are tickboxes to force the resolution, frame rate and compression profile to match the source footage. Frame-rate mismatches should, therefore, be a thing of the past.

There’s an opportunity to set the resolution and frame rate of the timeline when creating a new project, although you may as well ignore this since the software automatically changes these to match the first imported media. Confusingly, the timeline counts up to 30 frames for

each second, regardless of the source footage. In fact, it does use the correct number of frames per second on the timeline, but it skips or duplicates the numbered frames as necessary to give the

required number.

My final complaint? There’s still no support for 2.7K resolutions on the timeline. While this won’t be an issue for most people, it means the software refuses to apply its excellent Shake Stabilizer effect to 2.7K GoPro footage (a complaint I raised in my review of Premiere Elements 13).

The revamped export facilities are the unlikely highlight of the Premiere Elements 14’s features, but as for the rest, it’s frighteningly slim pickings. This is not an update existing users will be queuing up for.

Premiere Elements remains the best editor for newcomers who want a video-editing package they can grow into. However, Adobe must realise that its competition isn’t standing still: as a more experienced user, I now prefer Sony Movie Studio Platinum with its streamlined efficiency and greater attention to detail. **BEN PITT**



Keyboard shoot



WIRED

**Cherry MX-Board 3
(MX Red switches)**

SCORE ★★★★★

PRICE £45 (£54 inc VAT)
from cclonline.com



WIRED

**PC
PRO**
RECOMMENDED

**Cherry MX G80
(MX Blue switches)**

SCORE ★★★★★

PRICE £45 (£54 inc VAT) from
ballicom.co.uk



WIRED

**Cherry Strait Corded
Keyboard (JK-0300GB)**

SCORE ★★★★★

PRICE £26 (£32 inc VAT)
from amazon.co.uk



WIRED

Cherry Stream 3

SCORE ★★★★★

PRICE £19 (£23 inc VAT)
from cherry.co.uk

The feel of keyboards is a matter of taste, and the MX Red switches used here (look out for the Y in the full G80-3850LYGB-2 model number when buying) may not suit everyone. They can't match the mechanical heft of MX Blue switches, but they are quieter.

The MX-Board 3 is more "modern" than the plain G80, with volume controls, a lit Cherry logo and a compact design. This means the keys are a little squeezed together by comparison, but in practice this isn't a problem. Gamers and superfast typists will appreciate that it has n-key rollover, with the ability to identify up to 14 keystrokes at a time (some keyboards can only cope with one stroke at a time).

One oddity is the detachable USB cable, which can become damaged after prolonged use. But, this minor risk aside, this is another great Cherry keyboard.

This is a keyboard for true aficionados. People who appreciate the fact it uses MX Blue switches (identified by the S in its G80-3000LSCGB-2 model name), which give the keys a spring-like push-back and are the reason it's so darn noisy. It's suited to people who bash out thousands of words a day in the quiet of their own office, and it's certainly built to last: the characters are etched using a laser (you can feel them under your fingers) and there's a rugged finish to the design.

What you don't get is any frill. It's wired, not wireless; there are no media-playback keys; and don't even think about asking if the keys are backlit. It's big, too, so you'll need a large desk.

To the untrained eye it may also seem expensive, but for the quality you're getting here - and the likely life of this keyboard - it's a bargain.

This quirky keyboard aims to marry Apple style with Cherry substance, and largely succeeds. Whilst the chiclet keys don't have much travel, and can feel a little unresponsive, they're pleasant to type on.

I'm less impressed by the keyboard layout, with the Home and End keys positioned oddly in a two-column, three-row grid. It also sits at a very slight angle, with no way to raise it any further at the back. Typists should expect characters to wear off after vigorous use, as they're only stickered on.

The grey is plastic rather than the metal of Apple keyboards. That said, it's a fine alternative, complete with media playback controls and an attractive price.

Cherry keyboards have a reputation for great quality and high prices, but the Stream 3 appeals to those on a tighter budget. There are no MX Blue or Red switches here, just well-built kit.

The ABS plastic coating protects against misuse, while the key characters are laser-inscribed so won't wear away. Plus, there few "features" to go wrong: just media playback controls and three blue status LEDs.

The keys don't have the same high-quality, tactile feel of the MX keyboards, but you should be pleased by the travel and lack of key clatter.

What's special here is the price and the reliability: Cherry claims a mean time between failures of over 80,000 hours.

"What's special is the reliability: Cherry claims a mean time between failures of over 80,000 hours"

out

Tim Danton reverts to type as he tests eight of the best keyboards available for desktop PCs, mobile devices and even smart TVs



WIRELESS

Logitech K480 Bluetooth Multi-Device Keyboard

SCORE ★★★★★

PRICE £26 (£32 inc VAT)
from alza.co.uk



WIRELESS

Logitech Wireless Touch K400 Plus

SCORE ★★★★★

PRICE £27 (£33 inc VAT)
from amazon.co.uk



WIRELESS

Microsoft All-in-One Media Keyboard

SCORE ★★★★★

PRICE £21 (£25 inc VAT)
from amazon.co.uk



WIRELESS

Microsoft Wedge Mobile Keyboard

SCORE ★★★★★

PRICE £41 (£49 inc VAT) from
novatech.co.uk

Take three Bluetooth keyboards into the study? Not if you buy the K480, which can pair with up to three devices at any one time: a dial at the top left lets you select 1, 2 or 3, and then you can flip between your PC, phone and tablet.

That's not the end of its skills, either. It can hold a phone and tablet simultaneously via its generous integrated cradle, should you wish to.

The keys have an odd, round design. This gives the K480 a Fisher-Price feel and it's not the most sophisticated when it comes to the overall "typing experience". There's not much tactile feedback – novelists need not apply – and little travel. And note that it weighs a hefty 820g, so isn't designed for life in a bag.

Nevertheless, this is a versatile keyboard that can, in particular, turn your tablet into a proper little computer. And it does that very well.

Surprisingly for a keyboard that's intended to be used whilst watching TV, the # key is tiny – how are you meant to join trending conversations? As a way to navigate a smart TV's menus, though, it's great: plug the tiny USB receiver into a spare port and go.

The keyboard is so compact and light you can shove it to the side of the sofa without a worry. Plus, if you ever need to call upon a cursor control, then the built-in trackpad works just fine.

Logitech claims that the K400's AA batteries will last for a year and that it has a wireless range of up to 10m. Even though it's lightweight – the same can be said for the key action – it's also tough: Amazon reviewers talk of the K400 lasting well in the rigours of a household.

I would go for the Microsoft equivalent simply because it's cheaper, but it's a close call.

There's nothing flash about this keyboard. It's grey, plasticky and functional. But it's also a bargain if you're looking for a wireless keyboard to float between the home office and the living room.

That said, I wouldn't want to type a novel on it: the keys lack feedback and are tightly placed. Unlike some, though, Microsoft hasn't cut down the key size so it's easy to hit a respectable pace.

The trackpad is massive and supports multi-touch, for easy swiping, scrolling and zooming. I'm not a fan of the left/right-click buttons being built in – you always have to check where you're hitting them – but it's not a big issue.

Best of all, the spill-resistant design means liquids stay on the surface rather than seeping in.

Not a millimetre of this keyboard's 300mm width is wasted, with full-sized keys helping me hit similar speeds to a "proper" keyboard. The only real compromise is the tiny cursor keys, with Microsoft even finding space for shortcuts such as charms and settings.

It's powered by two AAA batteries, which slot into the eponymous plastic "wedge" on the keyboard's underside. It's a bit irritating in the bag, but helps provide a natural typing angle.

The plastic cover also doubles as a stand for your mobile device.

It has some heft, easily supporting a tablet's weight, and can be used with most devices via Bluetooth.

The Wedge Mobile isn't cheap, but is perfect for life on the move.

"The spill-resistant design means liquids stay on the surface rather than seeping in"

Amazon Fire HD 10in

The retail giant's low-cost 10in tablet is family-friendly and great for Amazon Prime subscribers

SCORE ★★★★★

PRICE £142 (£170 inc VAT)
from amazon.co.uk

It's tempting to compare tablets such as the new Amazon Fire HD 10in with the competition: the likes of the Apple iPad mini or Google's Nexus 9. It's tempting, but wrong.

You can line them up and look at the specifications. Compare the cameras, the screen quality, whether or not there's a microSD slot (for the first time, a Fire tablet has one). But, in truth, the only way to work out whether the Fire HD 10 is right for you is to consider how it fits into your life. If you don't subscribe to Amazon Prime, then head to Go and collect your £200: there is nothing for you here.

If, on the other hand, you pay £79 per year for Amazon Prime, there are plenty of reasons to like this tablet.

The first is that it's a great way to watch movies. There's just enough bezel at the left and right extremes for fingers to rest, the screen pumps out vivid colours and the built-in speakers pack enough grunt to enhance the action, while the processor can keep up with demanding scenes.

It's helped by being so light. Considering there's a 10.1in display, I was pleasantly surprised by how easy it was to hold for long periods. As part of the strenuous, real-world testing I'm sure you've come to expect from *PC Pro*, I watched over an hour's worth of *Rush* lying on the bed and didn't notice the 432g weight at all.

Battery life is pretty decent, too. You can expect around nine hours if you're just watching video, and you can download films from Amazon Instant Video. If you have a long plane journey or need to entertain the kids, the Fire HD 10 is your friend.

This is where the microSD slot comes in handy. You can buy 64GB cards for £15 from, well, Amazon, which means there's little point in paying the extra £30 for the 32GB version. With even a few handfuls of apps installed, there was only 11GB of internal storage available from the theoretical maximum of 12.8GB. The 720p version of *Rush*, a two-hour film, used 3.8GB of space.



ABOVE The Fire HD's 432g weight makes it easy to hold over long periods of time

If the Fire HD 10 is an excellent partner for video, though, its charms start to wane elsewhere. It's fine for reading books, but I found myself switching from portrait mode as the 16:9 aspect ratio screen extended too far. It was more comfortable to read books in two-column format when held in a landscape position. Personally, I prefer to read on a Kindle Paperwhite, or even an old-style Kindle without a built-in light.

Nor is it the best choice for games. While *Jetpack Joyride* and *Blood & Glory* both played well, its benchmark scores indicate how underpowered it is compared to similarly priced tablets. For instance, a multi-core Geekbench score of 1,512 is half that of Google's Nexus 9. This is a decent gaming device rather than a great one.

This can be forgiven, but it's a sign that Amazon isn't making full use of the quad-core MediaTek processor inside. It's held back by a miserly 1GB of RAM, but even then I wasn't expecting the amount of judder I

experienced in daily use. Most of the time, the Fire 10 feels fast, but then you pull up the list of apps and it stutters. I found exactly the same problem when browsing rich sites such as *The Guardian*.

This is where you notice the 10in panel's 1,280 x 800 resolution. It's fine if you're watching video, but there's a graininess to web pages, especially if you're used to high-density phone screens or Retina iPads. Nor is it the most accurate: it hit just 81.8% of the sRGB colour gamut in our tests. None of these are necessarily killer problems, but they do make the HD 10 feel like a budget tablet.

That brings me to Fire OS, now updated to version 5. It's the aspect of Amazon Fire tablets many people find disturbing. It's Amazon's own version of Android 5, but Google's UI team will find little familiar here, other than the list view of installed apps.

Instead, think of it as a way to browse your purchased Amazon content. Swipe left and you'll see your downloaded books, recently watched films and videos, games, a shopfront for Amazon itself, apps, music, audiobooks and a selection of magazines and papers on Newsstand.

Each section heading attempts to draw you in with recently viewed,

"The Fire HD is fine if you're watching video, but there's a graininess to web pages, especially if you're used to high-density screens"



LEFT The Amazon Fire HD's rear-facing camera feels rather like a tickbox

BATTERY: video playback, 9hrs 5mins



downloaded or read items, with what Amazon hopes will be a tantalising glimpse at other morsels: newly added films on Prime, for example, or recommended books.

What you won't find is Google Play or any Google apps. Click on Maps, for instance, and you'll see the unfamiliar mapping style of Nokia's Here offering. This delivers all the mapping and routing capabilities of Google's Maps, but it's less easy to use. There's no Chrome – you have to use Amazon's own Silk web browser. Most agonisingly, there's also no YouTube or Drive.

Elsewhere, it's more hit and miss. There's a BBC Sport app and Netflix, but no Sky Go or BT Sport. Plus, try and download the Instagram app and you'll be hit with a "This app is not compatible with your device" message. Clumsy.

If you fire up the camera, be prepared to be underwhelmed. Amazon has gone for intense, oversaturated colours to cover up (the cynic in me might argue) the lack of detail and high amount of noise in the shots. The front-facing camera is fine for Skype, but the rear camera is very much a tickbox.

However, this may not matter to you, and Amazon's free Underground app store is built into this Kindle. You could definitely argue that this adds to its value, even if it is possible for other Android tablet owners to install Underground if they jump through various hoops.

Underground helps to make it feel like a family-friendly tablet, too. The fact you can allow children free passage to download anything marked "Actually Free" is one fewer thing to worry about, and there are no nasty surprise in-app purchases.

Amazon has made other efforts to create a family-friendly device. You can give separate logins to your partner and up to four children, with the kids' accounts controlled by age. You can restrict usage times and allow them to earn playtime using educational apps.

For £1.99 per month, you can even give one of your children access to an "unlimited" number of kid-friendly apps, books and videos (£4.99 for up to three children). Note that there are only two age bands – three to five and six to eight – and the eight is generous. My eight-year-old was not impressed by series one of *Lego Friends*.

This indicates another problem: Amazon appears to think that children stop ageing at around



ABOVE The 10in screen and ease of use make the Fire a good choice for the tablet novice

seven. Even my 14-year-old's account was restricted to a simple interface that works beautifully for infant schoolers, but made him look at it once and hand the Fire back to me with a dismissive shake of the head. Suddenly, the fact you can only have two adult accounts looks like a massive hindrance.

So, should you buy it? The two best plus points are the 10in screen and ease of use: a novice will have no problem with the Amazon Fire HD 10. If all you want to do is browse the web and view Amazon content, its limiting approach has merit.

However, if you want something more versatile, there are other, more tempting, options. If you're willing to forgo an inch of screen size, then Google's Nexus 9 is far superior. At £180 from Argos, it's far more tempting, even to Amazon Prime subscribers such as me. **TIM DANTON**

SPECIFICATIONS

Quad-core MediaTek MT8135 processor (2 x 1.5GHz, 2 x 1.2GHz) • 1GB RAM • 16GB storage • microSD slot • 10.1in 1,280 x 800 IPS display • 0.9/5MP front/rear cameras • 802.11ac Wi-Fi • Li-ion battery • Amazon Fire OS 5 • 1yr RTB warranty • 159 x 7.7 x 262mm (WDH) • 432g

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Apple iPad mini 4

The iPad mini 4 is quite simply a brilliant tablet, but, if you're paying this much, consider an Air 2 instead

SCORE ★★★★★

PRICE 16GB, £266 (£319 inc VAT); 64GB, £333 (£399 inc VAT); 128GB, £399 (£479 inc VAT) from apple.com/uk

If the iPad Pro was the headline act of Apple's autumn event, the iPad mini 4 was definitely one of the backing singers: largely hidden, but still an indispensable part of the band's line-up.

There's no skimping on the build quality of the iPad mini 4. It's the same design that has served well for a couple of generations, with a beautiful aluminium body available in gold, "Space Grey" and silver. The body has shrunk slightly, though, with the iPad mini 4's dimensions of 134 x 6.1 x 203mm proving just a mite more slender than the iPad mini 2's 135 x 7.5 x 200mm (see our full review of the mini 2 on p82). You'd be pushed to notice the difference between the two devices by simply glancing at them.

There are hardware buttons for power and volume, as well as the ever-present home button on the front. You won't find a mute button, though, as this is now banished into software. The speakers have slightly

BATTERY: video playback, 17hrs 45mins



changed, too, with a single row of holes rather than several, but it hasn't harmed audio output.

One difference you'll notice over the iPad mini 2 is the screen: Apple has included a new panel that knocks spots off the old version. It's still the same 2,048 x 1,536 resolution, making for a crisp 324ppi, but the colour gamut has been improved, making it much more accurate than older models. At last, the iPad mini has a screen to match the iPad Air.

The 8-megapixel rear-facing camera enjoys an upgrade too. It produces fine results in daylight, and you only really start to see its limitations indoors or in lower light. There are the usual slew of standard Apple camera features: panoramas, 1080p video and 120fps slow-motion video, all of which again suffer indoors but are perfectly adequate outside.

Then there's Touch ID. This can, of course, be used simply to log in to the device, but it's also the key to using Apple Pay on the iPad. There is no NFC built in, so you can't use it as a contactless card, but you can use it for the App Store and in-app purchases if the developer supports Apple Pay, which is useful.

iOS 9 is a big step forward for all recent iPads, but the iPad mini 4 is the first small Apple tablet to take full advantage of its most powerful features. Unlike its predecessors, the mini 4 can use Split View to have two applications running on screen at the same time.

That's because, inside the iPad mini 4, you'll find an Apple A8 processor. It's not the same as the A8X in the iPad Air 2, which has improved graphics performance, but, compared to the previous generation, it's a decent boost: it scored 3,058 in Geekbench's multi-core test, compared to the mini 2's 2,475.

However, benchmarks are only a proxy for real-world performance, and here we were actually a little disappointed. Despite being obviously quicker than its predecessor, some games such as Star Wars: Uprising still had occasional little stutters.

The bigger question is exactly how valuable the Split View feature is when using a



ABOVE The gorgeous new screen, backed by a faster processor, is what separates the mini 4 from the mini 2

smaller-screen iPad. Sure, you can have two applications on screen at the same time – but why? While you might want to dive into Messages to fire off a quick reply, would you want both Messages and Safari open on a screen this small?

Battery life is as good as Apple has taught us to expect, with the iPad mini 4 returning a time of 10hrs

43mins in our video-rundown test – and that was with the brightness set to 170cd/m².

So, all told, Apple has created an amazing, tiny, powerful tablet. The question is, do you need

that much power, or can you make do with the still superb mini 2? Or do you upsize to an Air 2? When the 64GB version of the mini 4 costs so much – 16GB surely isn't an option – it's hard to recommend. **IAN BETTERIDGE**

SPECIFICATIONS

Dual-core 1.5GHz Apple A8 processor • 2GB RAM • 16GB/64GB/128GB storage • 7.9in 2,048 x 1,536 Retina display • 1.2MP/8MP front/rear cameras • 802.11ac Wi-Fi • Bluetooth 4.2 • optional 4G • 5,124mAh Li-poly battery • iOS 9 • 1yr RTB warranty • 135 x 6.1 x 203mm (WDH) • 299g

LEFT The iPad mini 4 looks undersized compared to the iPad Air and Pro



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Mobile apps

Outline

SCORE ★★★★★

PRICE £8.99

iOS 9 or later

Everyone writes notes, but some note-takers are more obsessive than others. If you're a casual note-taker on iOS, there are plenty of options, from the built-in Notes app through to big names such as Evernote and Microsoft's OneNote.

If you're a note-taking obsessive, though, you'll often find that these apps are much simpler than their desktop cousins. That's not down to the capabilities of iPhones or iPads – after all, these platforms happily handle other powerful software – so what do you do if you want a more powerful note-taking app?

This is the space that Gorillized want to fill with Outline. Open up a notebook and you'll find that the app has three levels of organisation: Notebooks, Sections and Pages. If this sounds familiar, that's because it's similar to Microsoft OneNote's structure. In fact, anyone who has used OneNote will find a lot

of similarities. That's not to say that Outline is a clone of OneNote, but it's clearly designed around the same metaphors and visual look and feel.

In fact, it goes a little further than looking like OneNote. Outline can open, read and write to notebooks stored on OneDrive or SharePoint.

Of course, you can do all this with the Microsoft Outlook client, which will cost you nothing. So why pay £8.99 for Outline? Putting it simply, Outline is to OneNote what Word is to WordPad – a more powerful option.

First of all, there's syncing. Unlike OneNote, which ties you to OneDrive, you can store your Outline notebooks

on Dropbox, iCloud and Box, or even sync them through iTunes for a non-cloud solution.

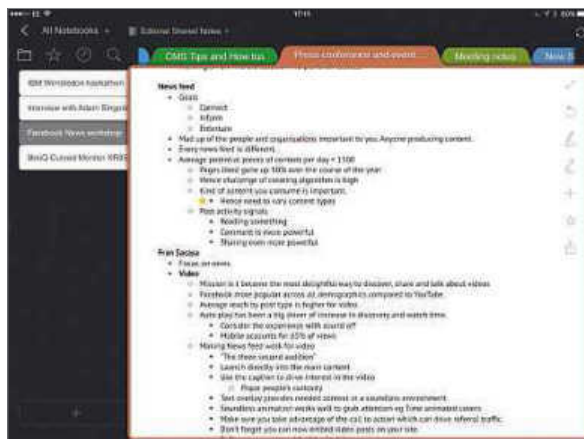
Once created, almost every other option is also much more powerful than OneNote. For example, Outline allows you to create tables of contents for sections or whole notebooks, which you can't do with OneNote. There's also great support for

“There's also great support for handwriting notes using a stylus: tap on the pen icon in a note and you get a panel at the bottom of the screen”

BELOW Outline isn't a clone of OneNote, but it has the same visual look and feel

handwriting notes using a stylus: tap on the pen icon in a note and you get a panel at the bottom of the screen. This handwriting panel has a “palm rest” area, where you can put your palm if you're using a pen that doesn't have built-in Bluetooth. It's a great, well-thought-out little feature typical of the attention to detail the developers have included throughout the app.

For anyone who wants a powerful note-taking app for iOS, Outline is the best I've seen, particularly if you're used to OneNote. However, is it really worth £8.99 when you can get OneNote for free? If you're an obsessive user, or simply want something like OneNote that doesn't require you to use OneDrive, the answer is an emphatic yes. **IAN BETTERIDGE**



New Star Soccer

SCORE ★★★★★

PRICE Free



Okay, it won't be the best-looking game in your collection, but you may well lose the most hours to it. Only they won't feel like hours – trust us on this one.

It's essentially a series of quite brilliant mini-games tied together to become a full RPG charting the life and journey of a professional footballer. Actions such as shooting, passing and heading are replicated on the pitch. Do well, and a big-money transfer beckons.

New Star Soccer app does contain micro-transactions, so it isn't genuinely “free”, but if you want to give it a go and remain unfettered by such things, a full Flash version of the game is available online. **ALAN MARTIN**

ABOVE Zero points for looks, but a winner for the addictiveness of its gameplay

Adobe Photoshop Fix

SCORE ★★★★★

PRICE Free



Photoshop has long been the mainstay of designers, photographers and internet meme-makers. This free iOS app is in no way a replacement for the in-depth editing tools that come with the full Photoshop release, but it's one heck of a starting point for beginners.

Angled towards patching up photos, the app has tools that give you the ability to warp faces, “heal” pictures by removing imperfections (or unwanted people in the shot), as well as a range of colour, focus and tone options. You can export layers to Photoshop CC, making it both a great ancillary tool and quickfire editor. The fact that all of these features are free is mind-blowing.

THOMAS MCMULLAN

ABOVE The app is a great start for people new to Photoshop's simpler functions

Microsoft Outlook

SCORE ★★★★★

PRICE Free

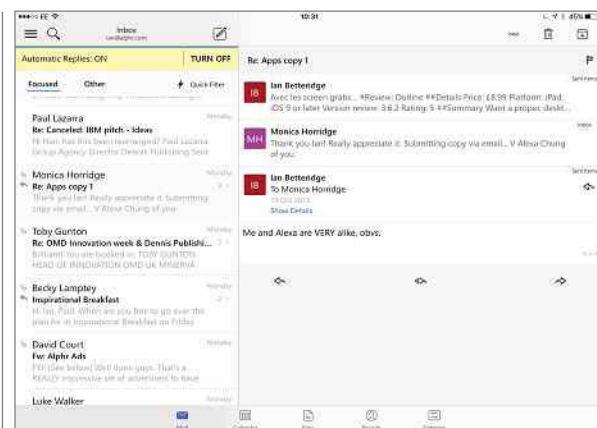


When Outlook for iOS was launched at the start of this year, it's fair to say that it had rough edges. Based on Acomplii, which Microsoft bought for over \$200 million in December 2014, Outlook for iOS (and later Android) lacked Exchange calendars and support for out-of-office messages, as well as being likely to crash.

However, even then the good outweighed the bad. This was a powerful email and calendar app that not only supported Exchange, but also Gmail, Yahoo and iCloud

accounts. To this, Microsoft has added support for any IMAP account, which immediately fixes one of the biggest issues with previous versions. You can also hook up cloud file services: not just OneDrive, but also Box, Dropbox and even Google Drive.

The key features are all about managing and triaging your email. Outlook includes a "Focused Inbox" view, which only shows the emails most important to you, based on what Outlook knows about how you respond to different people and messages. Anything that doesn't fit the bill is filed under "Other". If you've used third-party products such as SaneBox, which does the same thing but in the cloud, this approach will be familiar and very welcome. It makes a huge difference to reducing the clutter of the average inbox, and it's pretty good at working out what's important. If it does make a mistake,



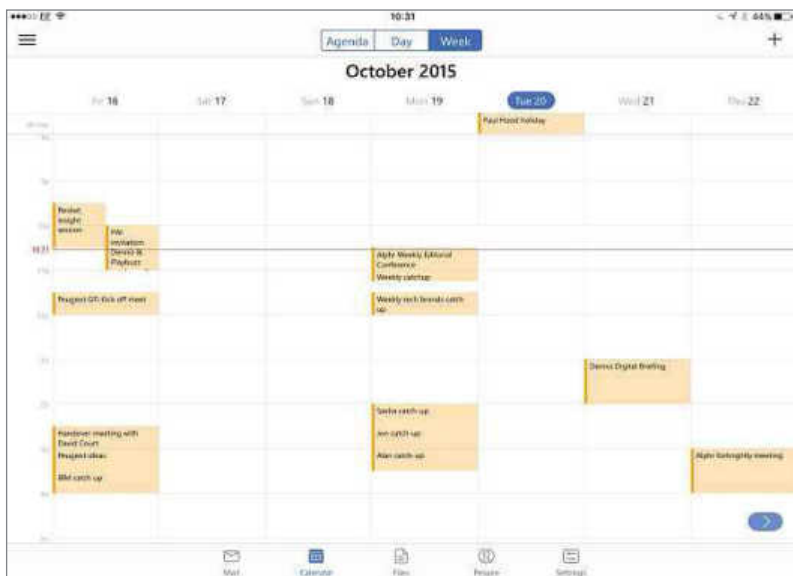
ABOVE The "Focused Inbox" function only shows your most important emails

you can correct it (and help it learn) by using a menu option to file the email into "Other" (or vice versa).

Triageing email is also simple. Swipe left to archive messages. Swipe right to "Schedule" them, removing them from your inbox until a later date and time. There's also a "Quick Filter" option that lets you filter to only see those emails that are unread, flagged, or have files.

Outlook's integration with files is a major plus point. There's a Files tab that allows you to pick documents to work with from all the supported file services. It also shows you files that are hiding in your inbox – a useful feature if you're trying to find a received file.

Overall, Outlook has now moved on from its "work in progress" status. Both iOS and Android versions now feel more stable, and integration of the files and calendar into a single app makes working much easier. If Microsoft can keep this up, then Outlook will be a huge win on mobile – and that \$200 million will start to look like a bargain. **IAN BETTERIDGE**



LEFT Microsoft Outlook proves to be a very powerful calendar app

DoggCatcher

SCORE ★★★★★

PRICE Free



One of the pleasures of smartphone ownership is the range of professional and fascinating podcasts available free of charge. Thousands of hours of entertainment are at your fingertips, if you know how to access them. Staying on top of the latest episodes and managing your phone's limited space, though – who has time for that?

DoggCatcher solves the problem for you. It recommends popular podcasts, checks your feeds and downloads new episodes as they appear. It won't just fill up your device either, removing episodes when done. There are other downloading options around, but DoggCatcher is an excellent jack-of-all-trades. **ALAN MARTIN**



ABOVE DoggCatcher is an excellent, and intelligent, jack of all trades for podcasts

Crumbles

SCORE ★★★★★★

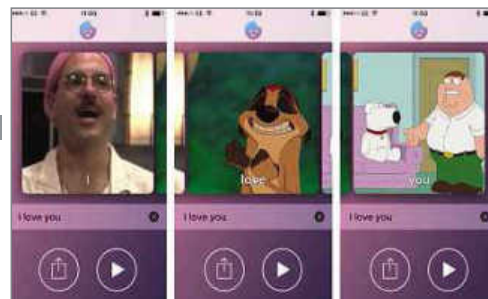
PRICE Free



This fun app creates instant

mashups of movies based around words you type. Write "I love you" and you might get Tobias Fünke from *Arrested Development*, Timon from *The Lion King* and Peter from *Family Guy* all chipping in to say it back to you in a video clip.

The app currently has a dearth of words in its banks, but it gives an option for you to fill in the blanks with a video of yourself. With time, the transitions will hopefully be made smoother, but for now it's an entertaining way to build and share short remixes with your friends. **THOMAS MCMULLAN**



ABOVE Send fun mashups to your friends based around words you type

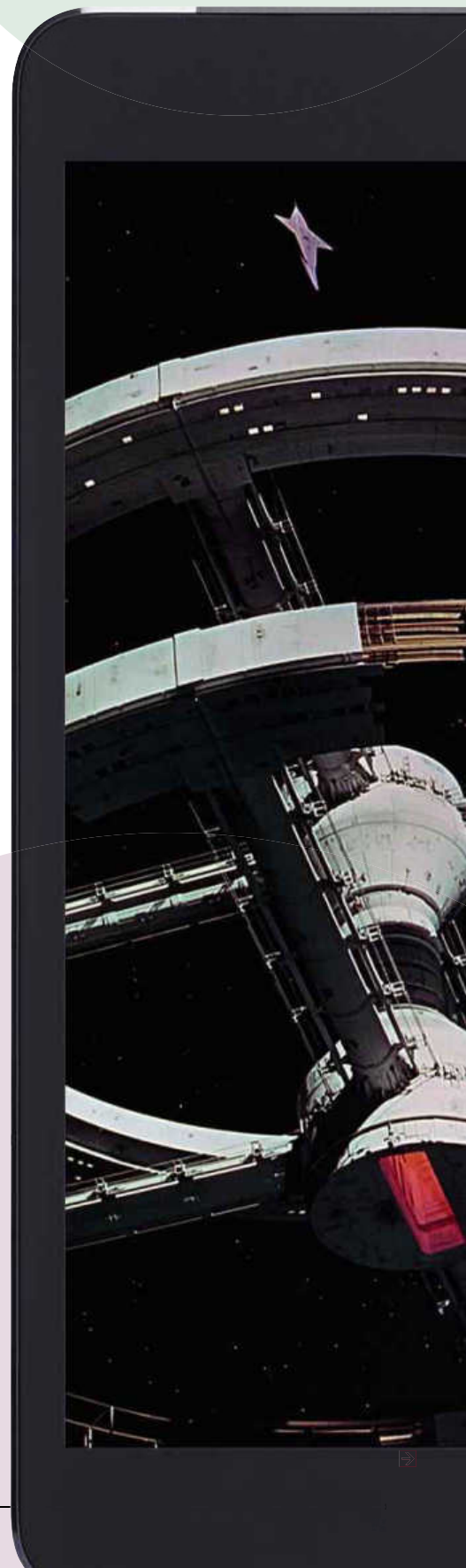


10 LOW-COST TABLETS ON TEST

Want a great tablet, but
don't want to spend a fortune?
Then this Labs holds the answer,
from the £50 Amazon Fire to the
budget-friendly iPad mini 2

Contents

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Buyer's guide

With prices tumbling and quality steadily improving, now is a great time to buy or upgrade a tablet

Prices are falling across most forms of technology. Yet, by any standard, the fall in the cost of tablets is little short of incredible. When the iPad launched, £400 was the entry level. Now you can buy a basic tablet for £50, while excellent mid-rangers with speedy processors and high-definition screens can be found for well under £200. Whether you're looking to try a tablet for the first time or upgrade from your old model, now is a great time to buy.

Your biggest decisions will involve software and size. Even at the low end, you have a choice of iOS, Android and Windows, not to mention Amazon's take on Android, Fire OS. iOS and Android remain the most versatile tablet operating systems with the greatest range of apps, but Windows 10 is a big improvement in this area and is surprisingly at home on smaller screens. Fire OS can be restrictive and has an unusual look and feel, but it's easy to use and perfectly effective, particularly as a vehicle for Amazon's own content.

■ Size

Here the market is changing, with both 7in and 10in tablets falling out of favour as manufacturers move to an 8-9.7in middle ground. More manufacturers are also ditching the widescreen 16:9 format and opting for an iPad-style 4:3 display, which makes tablets more usable for web browsing, email and apps, without seriously affecting films, TV and games. Whether you go for a compact or larger model will depend on what you're planning to use it for. If you

want a device that can do serious work or, with a keyboard, even moonlight as a laptop, then go large.

■ Display

The quality of the screen is one big deciding factor. Clearly, resolution is a major consideration, and paying more will take you from a 1,024 x 768 or 1,200 x 800 screen to a 1,920 x 1,080 or 2,048 x 1,536 one. While this will deliver better sharpness, clarity and detail, don't forget about brightness, contrast and colour. A few tablets that look excellent on paper can only

deliver a washed-out image that's invisible in sunlight, while others over-egg their colours to the extent that films and TV look unnatural.

The more pixels a screen has, the more

processing power you'll need to move them around. Quad-core and even octa-core processors based on ARM Cortex-A15 and A17 tech are now even available on budget Android tablets, so there's really no excuse for poor performance, but some tablets skimp on RAM. While older versions of Android were happy to run on 1GB or even 512MB, Android 5 (Lollipop) requires at least 1.5GB to run comfortably. Graphics performance is another key factor, with

huge differences in 3D power between, say, the Nvidia Tegra K1 used in Google's Nexus 9 and the Snapdragon 400 found in the LG G Pad 7.0.

■ Battery and connections

Bigger screens and faster processors always have an impact on battery life. With a laptop, we're used to the idea of charging frequently, but with a tablet, you expect to be able to dip in and out of using it over a number of days. A battery life of between seven and 14 hours is now typical, and we'd argue that a tablet that does any less just isn't worth having.

Finally, don't forget about storage, sensors and connectivity. Touchscreens and accelerometers are now ubiquitous, but some tablet manufacturers cut costs by dropping GPS. Dual-band and wireless 802.11ac Wi-Fi are well worth having if your router supports them, and if you can't afford more than 16GB of storage, make sure there's an SD slot to expand. Otherwise, more and more tablets are limiting physical connections to a single micro-USB, USB Type-C or Lightning socket. Luckily, the lack of micro-HDMI sockets doesn't mean a tablet can't output video. Some use Miracast or Wi-Fi Direct to transmit streams wirelessly, while others use an adapter cable or simply hook up to a Google Chromecast.

"A battery life of between seven and 14 hours is now typical, and we'd argue that a tablet that does any less just isn't worth having"

How we test

All the tablets went through the same test regime. We've used Geekbench 3 and GFXBench to assess processor and GPU performance, and used a colorimeter to check brightness, contrast and colour performance on each tablet's screen. We used the cameras and ran core apps to see how they work in general use, and looped 720p video with the screen set to a 120cd/m² brightness to gauge real-world battery life.





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			LABS WINNER			
	Acer Iconia One 8 (B1-820)	Amazon Fire 7in	Apple iPad mini 2	Archos 101 Oxygen	Asus ZenPad S 8.0 (Z580CA)	
Overall rating	★★★★☆	★★★★☆	★★★★★	★★★★☆	★★★★☆	
Price (inc VAT) ¹	£100 (£120)	£42 (£50)	£183 (£219)	£150 (£180)	£167 (£200)	
Manufacturer	acer.co.uk	amazon.co.uk	apple.com/uk	archos.com/gb	asus.com/uk	
Supplier	pcworld.co.uk	amazon.co.uk	apple.com/uk	archos.com/gb	amazon.co.uk	
Warranty ²	2yr RTB	1yr RTB	1yr RTB	1yr RTB	2yr RTB	
Dimensions (WDH)	130 x 9.5 x 215mm	115 x 11 x 191mm	135 x 7.5 x 200mm	240 x 10 x 172mm	135 x 7 x 203mm	
Weight	360g	313g	331g	570g	298g	

Hardware

CPU	1.33GHz Intel Atom Z3735G	1.3GHz MediaTek MT8217	1.3GHz Apple A7	1.8GHz Rockchip RK3288	1.83GHz Intel Atom Z3560	
GPU	Intel HD Graphics	ARM Mali-450	PowerVR G6430	ARM Mali-T764	PowerVR G6430	
RAM (options)	1GB DDR3	1GB DDR3	1GB DDR3	2GB DDR3	2GB DDR3 (4GB DDR3)	
Storage (options)	16GB eMMC	8GB eMMC	16GB eMMC	16GB eMMC	32GB eMMC (16GB, 64GB)	
Battery capacity	4,420mAh	Not stated	6,471mAh	7,000mAh	Not stated	
Accelerometer	✓	✓	✓	✓	✓	
Light sensor	✗	✓	✓	✓	✓	
GPS	✓	✗	✓	✓	✓	
3G/4G	✗	✗	Optional 4G	✗	✗	

Display

Type	LED-backlit TFT	IPS	IPS	IPS	IPS	
Size	8in	7in	7.9in	10.1in	8in	
Resolution	1,280 x 800	1,024 x 600	2,048 x 1,536	1,900 x 1,200	1,536 x 2,048	
Pixel density (ppi)	189	171	324	222	320	
Digitiser/active stylus support	✗	✗	✗	✗	✓	
Video outputs	✗	✗	✗	micro-HDMI	✗	
MHL/Miracast/Wi-Fi Direct	✗	✗	✗	Wi-Fi Direct	Miracast	

Camera

Rear camera resolution	5MP	2MP	5MP	5MP	8MP	
Focus type	Autofocus	Fixed	Autofocus	Autofocus	Autofocus	
Built-in flash	✗	✗	✗	LED	✗	
Front-facing camera resolution	0.3MP	0.3MP	1.2MP	2MP	5MP	
Max video resolution	1080p	720p	1080p	1080p	1080p	

Ports & connections

Wi-Fi standard	802.11n	802.11n	802.11n	802.11n	802.11ac	
Bluetooth standard	4	4	4	4	4.1	
Dual-band	✗	✗	✓	✗	✓	
Memory card reader	microSD	microSD	✗	microSD	microSD	
Other connections	micro-USB	micro-USB	Lightning	2 x micro-USB (1 x OTG)	USB Type-C	

Software & accessories

Operating system	Android 5.0.1	Fire OS 5	iOS 9	Android 4.4	Android 5.0.1	
App stores	Google Play	Amazon Appstore	iTunes App Store	Google Play	Google Play	
Bundled accessories	✗	✗	✗	✗	✗	



	Dell Venue 8 Pro 5000	Nexus 9	Lenovo Yoga Tablet 2	LG G Pad 7.0	Linx 1010
	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
	£218 (£262)	£150 (£180)	£167 (£200)	£92 (£110)	£154 (£185)
	dell.co.uk	store.google.com	lenovo.com/uk	lg.com/uk	linxtablets.com
	dell.co.uk	argos.co.uk	lenovo.com/uk	johnlewis.com	ebuyer.com
	1yr C&R	1yr RTB	1yr RTB	2yr RTB	1yr RTB
	130 x 9 x 216mm	154 x 8 x 228mm	255 x 7 x 183mm	114 x 10 x 189mm	255 x 10 x 166mm
	395g	425g	619g	297g	590g
	1.33GHz Intel Atom Z3740D	2.3GHz Nvidia Tegra K1	1.33GHz Intel Atom Z3745	1.2GHz Snapdragon 400	1.33GHz Intel Atom Z3735F
	Intel HD Graphics	Nvidia Kepler	Intel HD Graphics	Qualcomm Adreno 305	Intel HD Graphics
	2GB DDR3	2GB DDR3	2GB DDR3	1GB DDR3	2GB DDR3
	64GB eMMC	16GB eMMC (32GB)	16GB eMMC (32GB)	8GB eMMC	32GB eMMC
	4,830mAh	6,700mAh	Not stated	4,000mAh	7,000mAh
	✓	✓	✓	✓	✓
	✓	✓	✗	✗	✓
	✓	✓	✓	✓	✗
	Optional 3G	Optional 4G	Optional 4G	✗	✗
	IPS	IPS	IPS	IPS	IPS
	8in	8.9in	10.1in	7in	10.1in
	1,280 x 800	2,048 x 1,536	1,920 x 1,080	1,280 x 800	1,280 x 800
	189	281	218	215	150
	✗	✗	✗	✗	✗
	✗	✗	✗	✗	micro-HDMI
	✗	Miracast	✗	✗	✗
	5MP	8MP	8MP	5MP	2MP
	Autofocus	Autofocus	Autofocus	Autofocus	Autofocus
	✗	LED	✗	✗	✗
	1.2MP	1.6MP	1.6MP	1MP	2MP
	1080p	1080p	1080p	720p	720p
	802.11n	802.11ac	802.11n	802.11n	802.11n
	4	4.1	4	4	4
	✗	✓	✗	✗	✗
	microSD	✗	microSD	microSD	microSD
	micro-USB	micro-USB	micro-USB	micro-USB	micro-USB; 2 x USB 3
	Windows 8.1 Pro 32-bit	Android 5.1	Android 5.0.1	Android 5.0.2	Windows 10
	Windows Store	Google Play	Google Play	Google Play	Windows Store
	✗	✗	✗	✗	Keyboard dock



Apple iPad mini 2

The cheapest and oldest iPad's design and screen help it surpass its low- and mid-range rivals

SCORE ★★★★★

PRICE 16GB, £183 (£219 inc VAT); 32GB, £216 (£259 inc VAT) from apple.com/uk

It's now two years since the iPad mini 2 first appeared, but Apple has kept it relevant with small and strategic price cuts. Even now, with the iPad mini 4 (see p72) on the shelves, the mini 2 has a vital role to play. It's the affordable entry into the iPad world – and still one of the strongest small-screen tablets on the market.

That's a compliment to both Apple's design and engineering. Only 7.5mm thick and 331g in weight, the iPad mini 2 is slimmer and lighter than many of its rivals, with only the ZenPad S and Yoga offering more slender fits. The aluminium construction is solid and feels balanced whether in portrait or landscape, even when held in one hand. Its look and feel leaves Google's Nexus 9 in the dust.

The screen has the same 2,048 x 1,536 resolution as the iPad mini 4, not to mention the same pixel density of 324ppi. The mini 4 has seen some enhancements, but the older model's screen is still spectacularly good, reaching a high brightness level of 428cd/m² and a non-dynamic contrast ratio of 839:1. Blacks are deep, colours vibrant and clarity fantastic. Sound suffers from a lack of stereo speakers, but otherwise it's listenable, and fine for catch-up TV or playing games.

You might have expected the mini 2's A7 processor to have dated, with only two cores and the old PowerVR G6430 GPU to work with. However, the mini 2 is still competitive with newer tablets – with a Geekbench score of 1,374 single-core and 2,475 multi-core, it's the second-fastest tablet here. 3D performance is no longer the best, but the mini 2 can still hold its own with modern iPad games. Whether you fancy Angry Birds 2, Hearthstone or Real Racing 3, you'll get a good experience.

The mini 2 can't match the mini 4's 8-megapixel iSight camera, but the



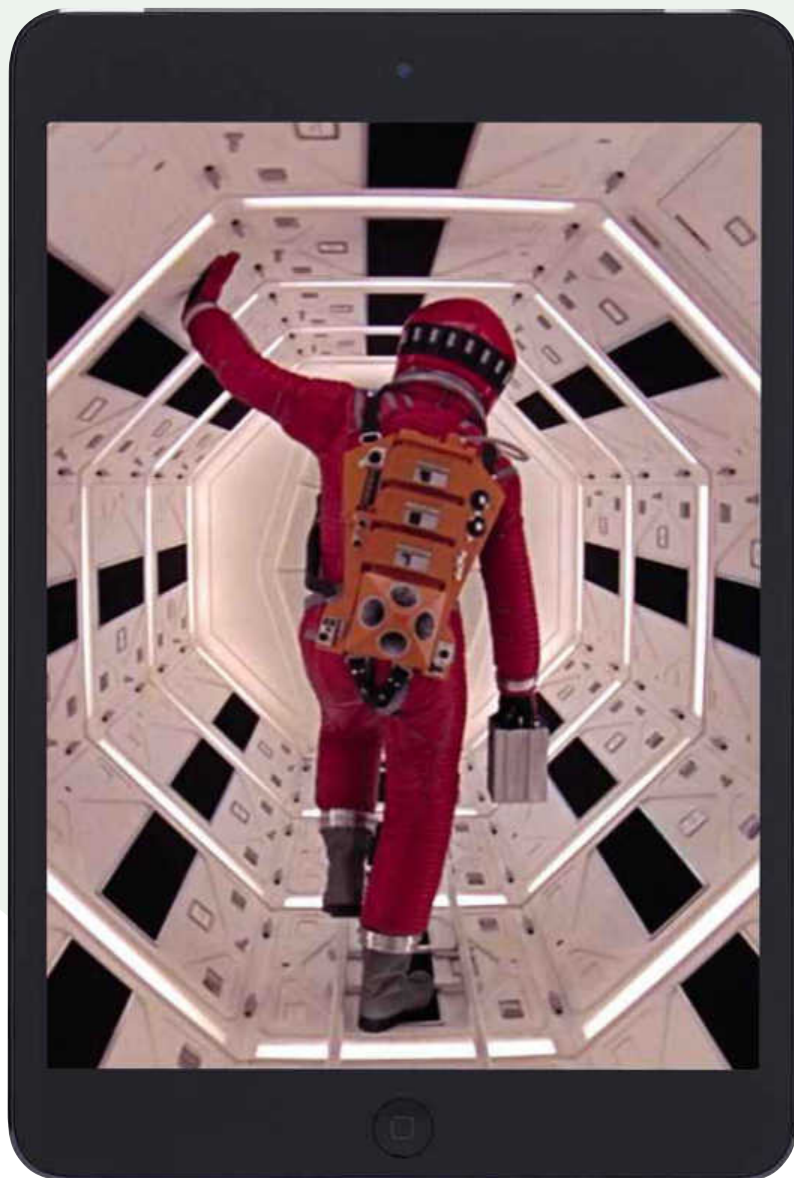
5-megapixel snapper on the rear delivers surprisingly crisp and well-exposed shots – and the iOS 9 camera app is Apple's smartest and most flexible yet. The 1.2-megapixel front-facing camera is fine for Skype or FaceTime video chats, and handles low-light conditions better than most Android or Windows competitors. Battery life may not be the best here, but it's still a strength: the mini 2's



ABOVE The iPad mini 2 is slimmer and lighter than many of its rivals

"Battery life is a strength: the iPad mini 2's 12hrs 17mins of HD video playback will see you through long-haul flights"

LEFT The screen has a high brightness level of 428cd/m²



12hrs 17mins of HD video playback will see you through long-haul flights.

However, there are two key areas where the mini 2 falls down. Wireless connectivity is fine, with dual-band 802.11n Wi-Fi and Bluetooth 4, but physical connectivity is limited to a single Lightning port. More seriously, to get the iPad mini 2 for less than £250 (our price cap for this Labs) we opted to test the 16GB model. 16GB

will get you a good selection of apps and enough space to hold music, movies and photos for a short trip, but you'll need to keep deleting things to avoid running out of space. The only way forwards is to pay an extra £40 for the 32GB model. We'd call that £40 well spent.

It's a predictable result, but Apple's little wonder is the best device on test. Google's Nexus 9 offers more power at a better price, but Apple has the edge on build quality and premium feel.

Q&A Inspiring teachers and students to code

The Computing curriculum is hugely exciting – and a massive challenge. Here, we speak to Shahneila Saeed, Programme Director of Digital Schoolhouse, on how her project is inspiring teachers and children

THE INTEL EDUCATION Summit, taking place in London on 1-2 December, shines a light on how technology is changing education. Digital Schoolhouse, backed by the Mayor of London and UKiE, is one shining example, with a lively, play-based approach to teaching computing. We caught up with Shahneila Saeed, Programme Director of Digital Schoolhouse, prior to the event.

Q What do you say to teachers who believe they can't teach computing?

A Teachers shouldn't be intimidated by the arrival of the new curriculum: computing isn't tough, it's fun! Learners today are immersed in technology throughout their lives, so this is one subject area where we don't have to work as hard to convince the students to be interested in. They already are interested! All we need to do as teachers is maintain that enthusiasm and interest, and engage the children with content they can connect with.

Making the subject matter relevant to students' lives can help increase learner engagement. Using play-based learning as a tool to emphasise computational thinking can bring a new perspective into the classroom. Computing techniques don't mean lessons restricted to a computer screen: magic tricks, dance,



playdough, board games and much more can all be used to teach computing concepts.

Stripping away the terminology and focusing on the underlying concepts helps you realise that it really isn't that difficult; and that there are so many ways in which you can teach it. With the Digital Schoolhouse, we use a play-based learning model to introduce primary age children to computational thinking, and give teachers the resources to teach computing confidently in fun and engaging ways.

Q What reaction have you had from teachers?

A We've had hugely positive feedback from the teachers using our workshops, which connect industry with the classroom in a series of play-based learning activities. We've seen teachers enter workshops lacking confidence in their own abilities to teach the new curriculum, and leaving the sessions having led their own discussions and used their own examples or analogies to explain concepts to pupils. When introduced to teaching the new computing curriculum in this way, teachers are inspired and motivated to go back to their classroom and try out new techniques and ideas. It's as much about educating the teachers as the children.

Q And from children?

A The children love coming to the Digital Schoolhouse workshops and are amazed by what they're capable of producing. Children naturally learn through play. By harnessing the power of play in the classroom with older children, we retain the sense of fun in learning, which leads to better interaction with the educational content. More and more, we're seeing children gain confidence in their own digital abilities and are encouraged to continue to develop their ideas beyond the Digital Schoolhouse workshops.



Q What inspires children to learn coding?

A Children don't necessarily think specifically about coding, but are naturally creative beings. They simply want to create things, they want to make things. That might be a game, a video, some artwork or a robot. Our workshops are designed to harness their natural desire for creativity and give them opportunities to learn computing as they play.

Q What are you hoping to achieve at the Intel Education Summit?

A It's a great place to meet delegates from a range of areas, and share ideas with colleagues. It's a fantastic opportunity to talk in detail about how to harness the power of play-based learning to improve computing education in Britain and show how the Digital Schoolhouse programme plans to build on our already successful model to achieve this. ●



ABOUT THE INTEL EDUCATION SUMMIT

The 12th Intel Education Summit will bring together over 200 local, national and European leaders in education, gaming and technology. This year, the impact of gaming on the future of education is a particular theme. The summit runs from 1-2 December and Alphr.com will have live stories from the event, along with exclusive interviews from speakers.





Acer Iconia One 8

Middling performance, low resolution and poor sound quality mean this budget tablet is way off the pace

SCORE ★★☆☆

PRICE £100 (£120 inc VAT)
from pcworld.co.uk

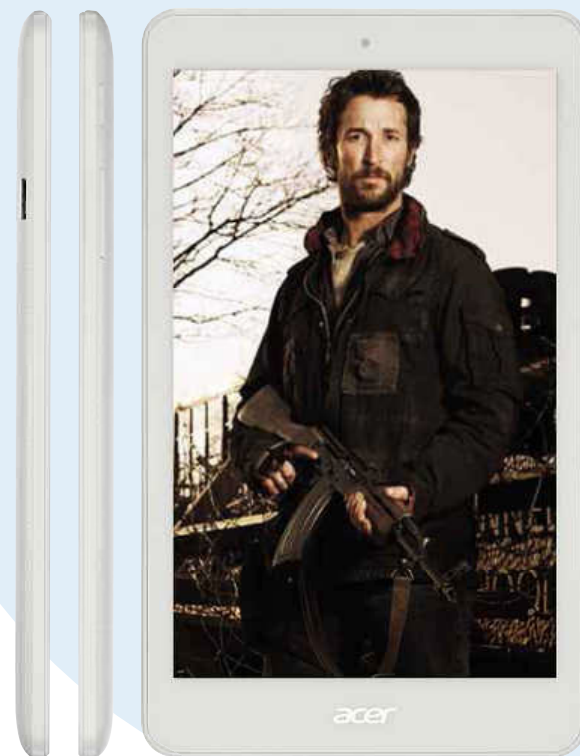
As part from a choice of colours, it's hard to imagine a more generic budget tablet than the Acer Iconia One 8. It's a chunky, solid little slate at 9.5mm thick and 360g, with a textured plastic back. Connections are limited to the classic micro-USB, headphones and microSD slot trio, while the power button and volume rocker are awkward to find at the right-hand side on the rear.

The Acer's specification is certainly nothing to write home about, either. A 5-megapixel rear-facing camera? A 0.3-megapixel front-facing camera? Quad-core Intel Atom processor? 1GB of RAM? They're all here. Performance is as middle of the road as you might expect, with enough power to launch

and switch between apps quickly, but not enough to run demanding apps with any degree of fluidity. And, while the Intel processor and limited 1,280 x 800 screen resolution mean that there's some 3D power, there's noticeable jerking when you run games such as Dead Trigger 2 or Asphalt 8.

The relatively low resolution and 8in panel leave the screen looking pixellated, but it's fairly bright at 334cd/m², and colours are reasonably natural by budget tablet standards. Other eight-inchers will give you far punchier hues and a crisper presentation – this isn't a great tablet for reading digital magazines – but movies and games look good, and it's perfectly fine for basic email and browsing. Sound, however, is bordering on terrible: weak, thick and congested, it's almost impossible to enjoy.

It's hard to work up any real enthusiasm for the Iconia One 8. It's not particularly fast, sleek nor even cheap, and is up against competitors with higher-resolution screens and better designs at lower price points. The tablet's most exciting feature is a super-sensitive touchscreen you can draw on with an ordinary pencil, but, given the low resolution of the screen, this seems a waste.



ABOVE The Acer Iconia One 8's display is fine for simple tasks such as basic email and browsing

The Acer's sheer ordinariness extends to its battery. Left to run HD video on a full charge, the Acer conked out 7hrs 20mins later. This isn't a bad budget tablet, but it's some way off the pace.

Amazon Fire 7in

A ridiculously cheap tablet, but the Amazon handcuffs and ageing hardware limit its appeal

SCORE ★★☆☆

PRICE £42 (£50 inc VAT)
from amazon.co.uk

Having already breached the £80 barrier with the Fire HD 6, Amazon has now dived down to £50 with this bargain-basement 7in Fire. It's not hard to see where the corners have been cut. Bar one giant logo, this is a generic, featureless slab with rounded corners and a little too much flex in its cheap matte-black plastic shell. The screen has also been compromised, with Amazon returning to the 7in, 1,024 x 600 combination of the original 2012 Kindle Fire.

With a pixel density of only 171ppi, it's not crystal clear, making digital magazines and websites hard to read. The screen's bright at 327cd/m², but contrast is low at 772:1 and colour

accuracy is poor. Yet, while this is the weakest Amazon screen so far, it's not unusable. Games, apps and videos don't actually look that bad – although Amazon Instant Video will only stream SD content, even if you have paid for HD.

A MediaTek MT8217 processor and 1GB of RAM limit performance. The Amazon Fire feels slow compared to the other tablets on test, with longer pauses when launching or switching apps, saving photos or opening a new browser tab. As a score of 14fps in the GFXBench T-Rex test underlines, it struggles when running 3D games. Battery life is merely adequate, with 7hrs 42mins of HD video playback.

Software is both a weakness and a strength. The new Fire OS 5, Bellini, is easy to use, with handy tutorials when you first set up the tablet and Amazon's Mayday remote-assistance feature to help if things go wrong. As long as you're a big user of Amazon's services – and preferably also a Prime subscriber – you'll get to what you're looking for quickly. But, while Bellini is more flexible than previous versions of Fire OS, it's still a little restrictive, and the same goes for Amazon's App Store, which consistently lags behind Google Play.

Compromises abound with the Fire. Storage is limited, Wi-Fi is



ABOVE Bar one logo, the Fire is a generic, featureless slab with too much flex in its plastic casing

bog-standard 802.11n, there's no GPS, and both the front and rear cameras are shockingly poor. However, £50 still buys you a reasonably accomplished tablet. You could do better on a bigger budget, but as a secondary tablet for family use, you could also do considerably worse.

Archos 101 Oxygen

A reasonably smart tablet that aspires to high-end status, but doesn't have the specifications to match

SCORE ★★☆☆☆

PRICE £150 (£180 inc VAT)
from archos.com/gb

The Archos 101 Oxygen is an example of how high-end features are sneaking into budget tablets, with the 101 Oxygen cramming a high-definition 1,900 x 1,200 screen into a 10.1in tablet for less than £200. Beyond that, we get a quad-core processor, 2GB of RAM and 16GB of storage. On paper, that's a decent specification for the money.

Look deeper and the deal isn't so compelling. The processor is a Rockchip RK3288 with four ARM Mali-T764 graphics cores. While its single-core Geekbench 3 score isn't bad, the multi-core result of 1,736 is a long way off the pace set by other Android slates. There's not enough 3D horsepower to run advanced

games smoothly at the native resolution, and the 101 Oxygen has odd pauses and stutters when you're loading complex web pages or switching apps.

Furthermore, this is the only Android tablet on test running Android 4.4 rather than Android 5. This doesn't make the tablet much less usable, but you miss out on the interface refinements and features introduced with the Lollipop release.

It's a smart-looking tablet, finished in powder-coated black with an aluminium shell. It's not particularly thin or light, but tapered edges help disguise the 10mm thickness. Yet, while the 101 Oxygen feels solid, there's too much of a gap where the rear meets the top edge, and some uncomfortable edges around the other sides. The screen doesn't live up to its billing, either. The 297cd/m² brightness is merely average, and while the 222ppi pixel density leads to smoother curves and more detail than on many 10in tablets, there's not as much punch. Sound is better, however, with more depth and a stronger stereo effect.



ABOVE The 222ppi pixel density means smoother curves and more HD detail than other 10in tablets

Connectivity is the 101 Oxygen's strength, with a micro-HDMI output and two micro-USB ports, one of which supports USB On-The-Go, not to mention Wi-Fi Direct video streaming. Battery life is also pretty strong: it lasted more than 10 hours of video playback. Overall, though, it's a tablet that aspires to high-end status without the specs or the finish to match.

Asus ZenPad S 8.0

A low-cost contender with snappy performance and excellent brightness, but the iPad mini 2 is better

SCORE ★★★★★

PRICE £167 (£200 inc VAT)
from amazon.co.uk

Having redefined expectations for a low-cost tablet with its Nexus 7 and Memo Pad 7 lines, Asus has the iPad mini and the Samsung Galaxy S2 in its sights with the ZenPad S 8.0. It's a stylish little number based around an 8in, 1,536 x 2,048, 4:3 aspect ratio screen, putting it toe to toe with the Samsung and Apple slates. But, in true Asus style, it's slightly cheaper, with this 32GB model creeping in at £200.

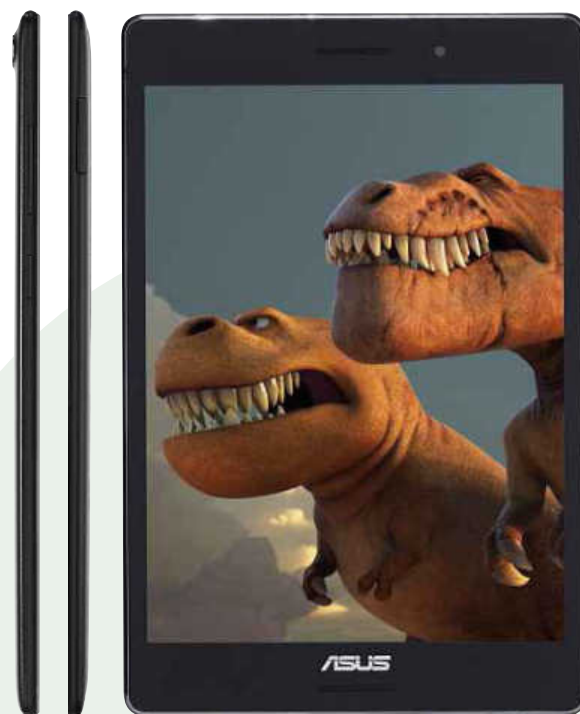
The back may be plastic, not aluminium, but there's style and practicality in the brushed-metal effect and faux-leather strip on the left-hand side. At just under 300g, it's also a very lightweight tablet, although the downside of the slimline

design is that there's more flex in the chassis than we'd like.

At first glance, the screen is a beauty. The 320ppi pixel density makes it one of the sharpest here, while colours are extremely vibrant. We measured brightness levels at 308cd/m² and contrast at 1,710:1, but the latter is boosted by dynamic contrast. This comes at the expense of colour accuracy and highlight detail. The Asus ZenPad still has a better screen than you'll find on most budget tablets, but it's no match for the iPad mini 2.

With an Intel Atom Z3560 and 2GB of RAM, performance is snappy. Apps launch quickly, complex web pages don't pose any problems and, while the Nexus 9 is significantly faster, there's enough 3D power to run most games. Both the Geekbench and GFXBench scores are above the level of most low-cost tablets. With over 13 hours of HD video playback, battery life is competitive too, while the 8-megapixel rear-facing camera picks up a fair amount of detail. It's just a shame about the overexposure.

Unfortunately, Asus lets itself down on the software side. We're not convinced that Asus's ZenUI interface enhancements add anything to the Android experience, and Asus has preinstalled a tremendous quantity of



ABOVE The back is plastic, but there's style and practicality in the metal effect and faux-leather strip

bloatware, while hiding Google's own apps away in a folder.

For all these complaints, the ZenPad S 8.0 gives you a lot of tablet for your money, but it's still caught between impressive low-cost models and stronger mid-range devices. We like it, but not quite enough.



Dell Venue 8 Pro 5000

Not an exciting tablet, but its onboard storage and easy upgrade to Windows 10 will appeal to businesses

SCORE ★★☆☆☆

PRICE £218 (£262 inc VAT)
from dell.co.uk

Dell has evolved its tablet strategy over the past few years, competing at the high end with Android devices such as the ultra-slim Venue 8 Pro 7000, while still delivering mid-range, business-focused Windows models such as the Venue 8 Pro 5000 here.

It's a heavyweight 8in tablet that feels a bit like the old Nexus 7 with added muscle. At 395g and 9mm thick, it's noticeably chunkier than rival eight-inchers. That said, it feels extremely solid, with a tough, rubberised shell that has a raised, concentric-ring pattern for added grip. The power button and volume rocker are accessible on the

right-hand side, and there's a microSD slot beneath a pull-off flap.

The combination of an 8in screen and a 1,280 x 800 resolution isn't thrilling, but the 189ppi pixel density is more than enough when you're running Windows 10. While you'll get smoother text and more detailed Full HD video on other tablets, at 313cd/m² it's still bright enough for use in everything except direct sunlight. Even then, an anti-reflective coating helps. Colour accuracy is fairly poor across the spectrum, with a tendency to over-egg the blues.

The Venue 8 Pro 5000 is just as businesslike in its core specification, with an Intel Atom and 2GB of RAM. Dell tells that its processor will be upgraded in the next few months, but current performance is fine for the kind of basic email, document-editing and web-browsing tasks you would expect to perform on a compact tablet. Geekbench 3 scores are a shade lower than the Linx 1010, but there's just enough speed for some light 3D gaming, with a 22fps frame rate in the GFXBench T-Rex benchmark.

However, for consumers, the Venue 8 Pro 5000 is a hard sell. The screen, processor and styling point towards a device that's half the price. That said, companies may look at the 64GB of onboard storage and the



ABOVE The Venue 8 Pro 5000 feels very solid, with a tough, rubberised shell and a ring pattern for grip

choice of Windows 8.1 Pro – easily upgradable to Windows 10 – and see it as a cost-effective solution. Other tablets on the market are more exciting, but this is a more than solid choice for work tasks.

Nexus 9

The most powerful Android tablet on test, but it just lacks the finesse to claim an award

SCORE ★★★★★

PRICE £150 (£180 inc VAT)
from argos.co.uk

When we first reviewed Google's Nexus 9, we came away a little disappointed. Here was a tablet going toe-to-toe with the iPad Air 2 and the Samsung Galaxy Tab 8.4, but without the build quality or finesse to go the distance. Now, however, you can often pick up a 16GB Nexus 9 for less than £200 (its price jumps about). So does the former high-end tablet make more sense at a mid-range price?

In many areas it does. The 8.9in, 2,048 x 1,536 screen is a beauty, is easily superior to everything else in this Labs other than the iPad mini 2. At 464cd/m², it's almost ludicrously bright, yet contrast levels are high and colour accuracy is near flawless. The

same compliments go to its viewing angles, and to its usability in very bright conditions.

Better still, there's also power to spare. The Nexus's Nvidia Tegra K1 processor can cope with any tablet workload. Not only does it have the highest Geekbench score of any tablet on test by some margin, but it can speed through the GFX Manhattan 3.1 test at 15fps, which runs on every other tablet at a 5fps crawl. If you want to play games or stream 1080p video, this is the Android tablet of choice. You won't even have to plug in headphones – the Nexus 9 delivers surprisingly rich stereo sound. Even battery life is good, with the Nexus 9 surviving more than 13 hours of HD video playback before eventually running out of charge.

In most respects, therefore, this is the best tablet on test – and one of only two featuring 802.11ac Wi-Fi. However, what lets it down is the design and finish. While slim and even lighter than the mighty iPad Air 2, the Nexus 9 lacks the premium feel and attention to detail of Apple's tablets. For example, it feels like it could easily fall apart if you twist it, and the rear gets uncomfortably hot when you push the processor hard. The problems continue: there is a bit of backlight bleed around the screen



ABOVE The 8.9in, 2,048 x 1,536 screen is a beauty, with high contrast levels and colour accuracy

and, with no microSD slot, you're stuck with only the 16GB or 32GB of storage provided. All the same, if you do find a Nexus 9 on sale for less than £200, it's an absolute bargain. In fact, putting aside the small issues with Google's tablet, it's desperately close to being an award-winner.

Lenovo Yoga Tablet 2

A successful break from the conventional slate design that falls marginally short of excellence

SCORE ★★★★★

PRICE £167 (£200 inc VAT)
from lenovo.com/uk

With a cylindrical bulge at the bottom and ingenious hinged kickstand, the Lenovo Yoga Tablet 2 stands out for its looks, but is practical too. Not only does the hinge contain the battery, trimming bulk from behind the screen, but it's great for gripping the device with one hand.

The stand has three modes: one near-vertical, one with the tablet lying almost horizontal and the stand propping it up underneath, and a third allowing it to be hung from a string or rail. Add a Bluetooth keyboard (not included), and the Yoga Tablet 2 is ready to work.

At over 600g, it's not a light tablet, and only the hinge and kickstand are

metal, with the rear finished in matching plastic. It still feels robust and has handy design touches, such as the hard-to-miss power button in the left-hand cap of the hinge.

The 10.1in screen has a Full HD resolution and a pixel density of 218ppi. This, when combined with a brightness level of 376cd/m², gives the impression of a crisp screen, but you'll still see weird halo artefacts around edges, while colour accuracy is poor. Despite this, it's good for entertainment – helped by Dolby stereo speakers in the stand that put out a more powerful, well-rounded sound than most tablets muster.

The Yoga Tablet 2 delivers the kind of performance we'd expect from a tablet with an Intel Atom Z3745 processor and 2GB of RAM. It feels snappy when you're navigating around Android, switching tabs in the Chrome browser or launching apps. It's only when you play more demanding 3D games that the Intel HD graphics core struggles.

Lenovo has added its own enhancements to the Android UI and utilities. It no longer ditches the app tray, and while Lenovo has duplicated



ABOVE The Lenovo's Yoga Tablet 2's large cylindrical bulge and hinged kickstand are unusual, but practical

Google's own core apps, the originals remain accessible in their own homescreen folder. There's even a basic multi-window feature, but it's limited to a handful of apps.

The Lenovo survived 10hrs 27mins in our battery test, which isn't a bad result for a tablet with a Full HD screen. It's not the perfect big-screen tablet, but it's as flexible as its name suggests and will appeal to many.

TeraStation™ 3200

When Versatility wins over Power.



www.buffalo-technology.com

In the land of the Sumo, size and power can sometimes come in smaller packages, as the new TeraStation™ 3200 will prove to you. The affordable NAS solution for small offices and demanding home users features an enterprise-class functional range, normally found in only high-end business storage. Designed in the country steeped in a tradition of martial arts, it offers superior reliability and security, keeping your critical data safe at all times.

- 2-bay NAS fully populated with 2, 4, or 8 TB
- CPU Marvell ARMADA dual-core, 1 GB DDR3 RAM
- Simultaneous NAS and iSCSI target functionality
- Buffalo Surveillance Server
- WebAccess
- Rich backup features including: Failover, Replication, and Amazon S3 cloud support
- Also comes with 11 licenses NovaBACKUP® Buffalo Edition



BUFFALO™



LG G Pad 7.0

Battery life is excellent and its added features have potential, but the screen and sound lag behind

SCORE ★★☆☆☆

PRICE £92 (£110 inc VAT)
from johnlewis.com

LG's first G Pad, the G Pad 8.3, was one of the best small-screen tablets of 2013, bringing the style and performance of the brand's smartphones to the tablet market. Sadly, while the G Pad 7.0 has been around for a year, it hasn't made as many friends. Too much about it is entirely mediocre.

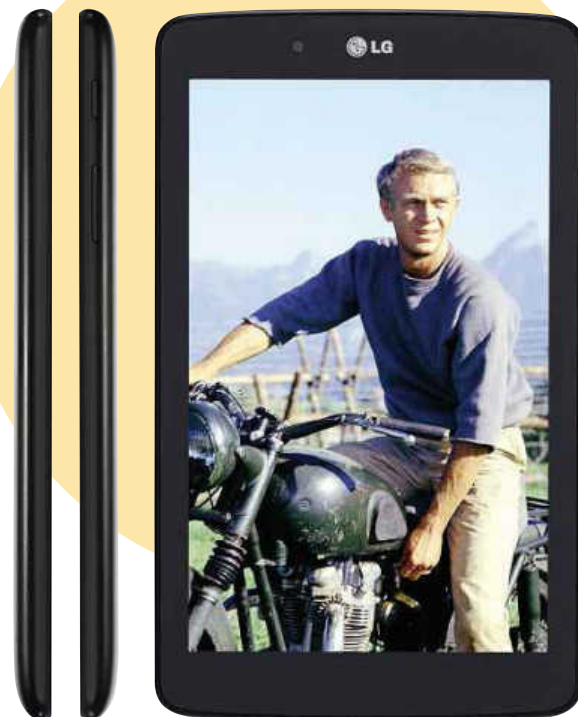
There's nothing much wrong with the design. With a curved black polycarbonate shell and toughened glass front, it feels a little like an oversized budget smartphone, but it's also light, well balanced and easy to hold. The power button and volume rocker protrude slightly from the right-hand side, while a pull-off cap conceals an SD slot – a necessity with

only 8GB of storage onboard, almost 6GB of which is occupied by the OS and apps.

LG doesn't go to the same lengths as Samsung to customise Android, but a few of its added features – such as the QPair app, which allows you to take calls and texts from a paired LG phone – have potential. There's also a basic split-screen feature, even if it only supports a small subset of core apps, and LG's Knock Code replaces passwords with a sequence of knocks on the screen. However, there's too much bloatware, while LG's work on the settings menu actually makes things harder to find. Furthermore, the custom keyboard is a cramped, over-busy nightmare.

The screen is bright and there's plenty of contrast, although the 1,280 x 800 resolution isn't particularly good for crisp text. Email and movies look fine, digital magazines and web pages less so. Sound, meanwhile, is so brash and tinny that it's virtually unbearable to listen to.

The G Pad 7.0 uses the same Snapdragon 400 chipset as the first- and second-generation Moto Gs, and the same rules basically apply: you won't have any problems running most apps or flicking between them, but this isn't a snappy device. Its Geekbench scores are among the



ABOVE The LG G Pad 7.0's curved shell and toughened glass front make it feel like an oversized smartphone

worst here. It really struggles with the GFXBench T-Rex test, and the GPU doesn't support the OpenGL ES 3.1 features required to run the Manhattan benchmark. The saving grace is battery life, with over 13 hours in our tests, but that's not enough for us to consider it a worthwhile buy.

Linx 1010

A good 10in tablet with the functionality and connections to become an even better netbook

SCORE ★★★★★

PRICE £154 (£185 inc VAT)
from ebuyer.com

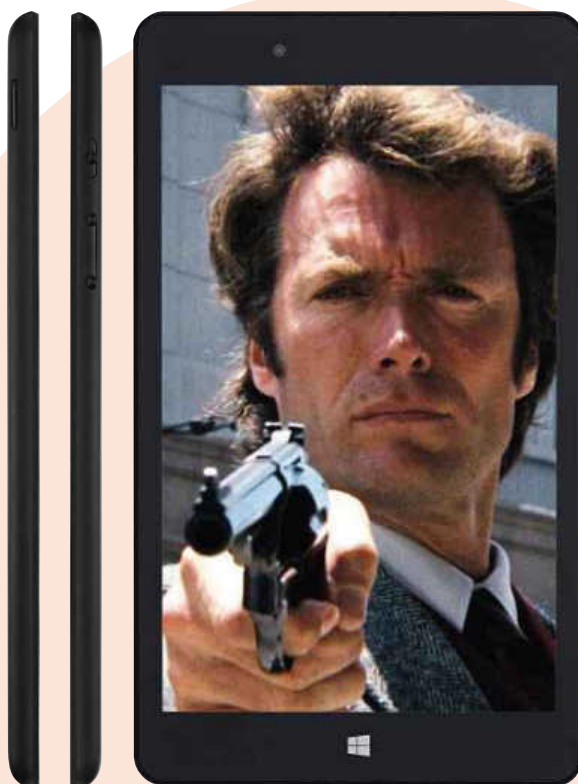
Linx impressed us earlier in the year with a budget 10in Windows tablet that proved more capable than expected. Now it is aiming to repeat the trick with the Linx 1010 – a revamped Windows 10 tablet with a 10.1in screen, optional keyboard dock and budget price.

It's not some kind of cut-price Surface 3 rival, though. The Linx 1010's screen is limited to a 1,280 x 800 resolution and, while the IPS panel delivers reasonable viewing angles, the brightness is only 278cd/m², making it a struggle to use in bright light conditions. That said, the Windows 10 UI looks clean, text is legible, and colour accuracy is pretty good. Sound is pathetically weak,

though, while the rear and front-facing cameras, which are both 2-megapixel, aren't going to deliver glorious snaps.

There isn't a surfeit of processing power, either. The Linx 1010's Atom Z3735F processor keeps Windows and mainstream apps running at a decent lick, and you can multitask with a browser and the preinstalled Office Mobile apps. The Geekbench scores are perfectly reasonable and, while we couldn't get the GFXBench Manhattan 3.1 test to run, the scores for the T-Rex test show that some lightweight gaming is possible. All the same, you need to be realistic. Throw Photoshop Lightroom at the Linx or keep too many browser tabs open and it will splutter.

One of the best things about the Linx 1010 is its flexibility. It can run the whole gamut of Windows apps, and a mere £15 extra will net you a full keyboard dock with a touchpad. The keys have a lacklustre action and the touchpad is small, but the layout isn't cramped, the docking mechanism works very smoothly, and the whole shebang is balanced to stop the tablet tipping backwards. What's more, the Linx 1010 doesn't just have a micro-HDMI and micro-USB port but two full-sized USB 3 ports – not bad for a low-cost option.



ABOVE The Linx's battery lasts for more than 15 hours when playing video

Overall, it's a decent tablet and, with the keyboard dock, a credible netbook. Most importantly the battery life is stellar and, with 15hrs 28mins of video playback, the best on test.

View from the Labs

If today's best budget tablets aren't about cutting-edge features, they can bring yesterday's high-end features to a wider audience, says **Stuart Andrews**

Just as rumours of the PC's demise have been greatly exaggerated, the tablet isn't going anywhere yet. Admittedly, there are worrying signs of stagnation. It won't have escaped your notice that the two best tablets on test aren't actually new, and that manufacturers are happy to release products that don't push any boundaries whatsoever.

Take LG and Acer's tablets. They are perfectly decent, but also deliver old technology at a slightly cheaper price. The Amazon Fire is incredibly affordable, but looks and feels like a relic from 2012. And while we couldn't get the Samsung Galaxy Tab A in time for a review, it's a little disappointing to note that the brand's biggest low-cost tablet for 2015 comes packing a 9.7in, 1,024 x 768 screen at an asking price of £179 – a combination that doesn't make any sense whatsoever.

Yet, if today's best budget tablets aren't about cutting-edge features or incredible performance, they can succeed in bringing yesterday's high-end features down to a wider audience. The Asus ZenPad S 8.0 can't



Stuart Andrews is a regular contributor and former PC Pro reviews editor

“When so many developers simply upscale smartphone apps to tablet screens, is it any wonder that tablet users feel underwhelmed?”

compete with the Samsung Galaxy Tab S2 or the iPad mini 4 on features, but when it's £80 to £120 cheaper, it doesn't have to.

There's an argument that the iPad mini 2 is all the iPad most of us will need, and it's £100 less expensive than Apple's latest model (see p72). The Nexus 9 had trouble going toe to toe with Apple, Sony and Samsung's best but, at current sale prices, it's an absolute belter. We're just sorry the Tesco Hudl

2 bit the dust just as we were going to press, as that was terrific value too.

There is still room for improvement, and a lingering sense that low-cost tablets should be doing more. There are

constraints in terms of battery power, heat and construction, but it would be great to see tablets with more power than equivalent smartphones, handling apps that wouldn't make sense even on a phablet screen. This

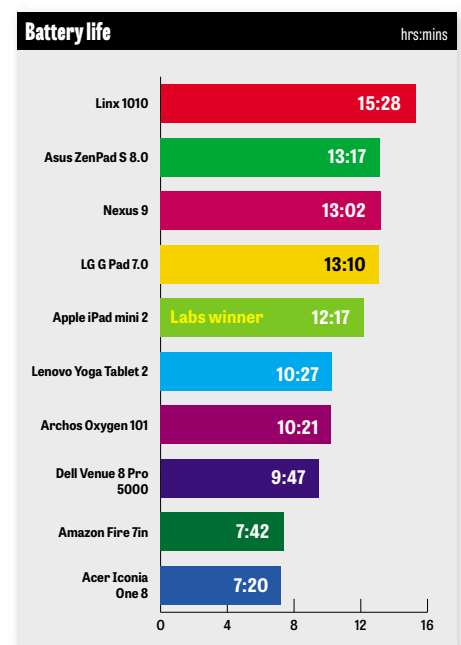
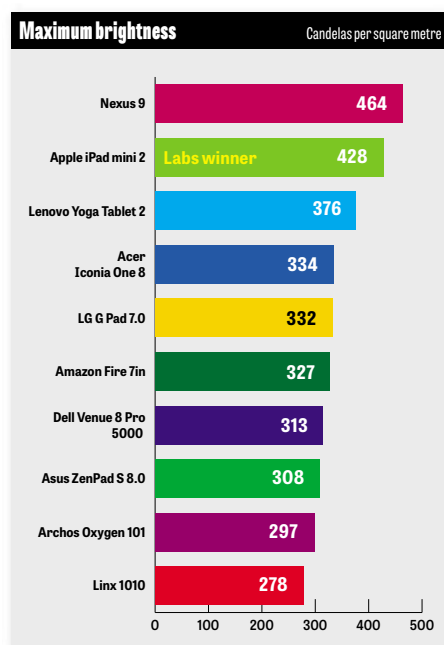
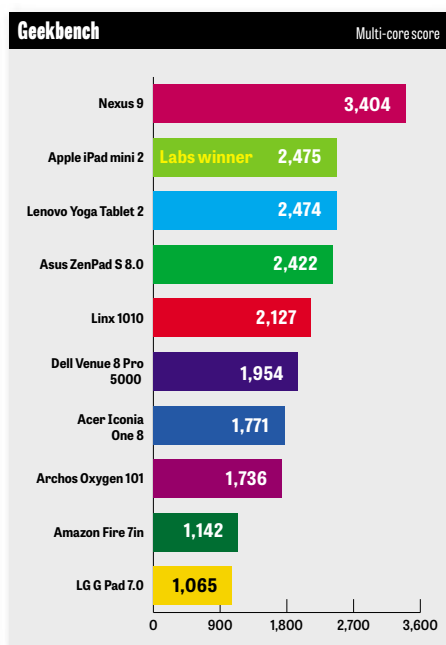


ABOVE The Lenovo Yoga Tablet 2 is a successful break from the conventional slate design

is mainly a software problem. When so many developers simply upscale smartphone apps to bigger tablet screens, is it any wonder that tablet users feel underwhelmed?

Microsoft and Apple have been doing good work here with mobile versions of powerhouse desktop apps, but Google and the Android development community need to step up to the plate, and deliver applications that can push the power of Android on a slate. ●

Test results



The Network



Practical buying and strategic advice for IT managers and decision makers

The Business Question

How effective is your website?
And is it stuck in the past? **p102**

Hands-on: Office 2016

How Office 2016 can help your
team work better together **p104**

Cheat Sheet

Steve Cassidy reveals all about
internet redundancy **p108**

BUSINESS FOCUS

Choosing the right NAS device

NAS appliances are no longer simply a box of RAID-protected disks. **Dave Mitchell** helps you make the best choice for your business



Small and medium-sized businesses (SMBs) are facing the same explosive data growth as enterprises, but their limited IT budgets mean they need to find the most cost-effective storage solution. The network attached storage (NAS) device is easily the most affordable, letting SMBs take total control of all their data and, unlike cloud storage, only incurring a single upfront cost.

NAS devices take the load off SMBs' servers by centralising data storage in one location while increasing capacity on demand, without affecting business operations and services. Even better, the latest NAS appliances have evolved way beyond being just a box of RAID-protected disks, with many offering features such as centralised backup, private storage clouds and remote access.

In this month's buyer's guide, we round up four rack and desktop NAS appliances from the biggest names in the market. We review their features and put them through their paces to help you make the right decision.

Good vibrations

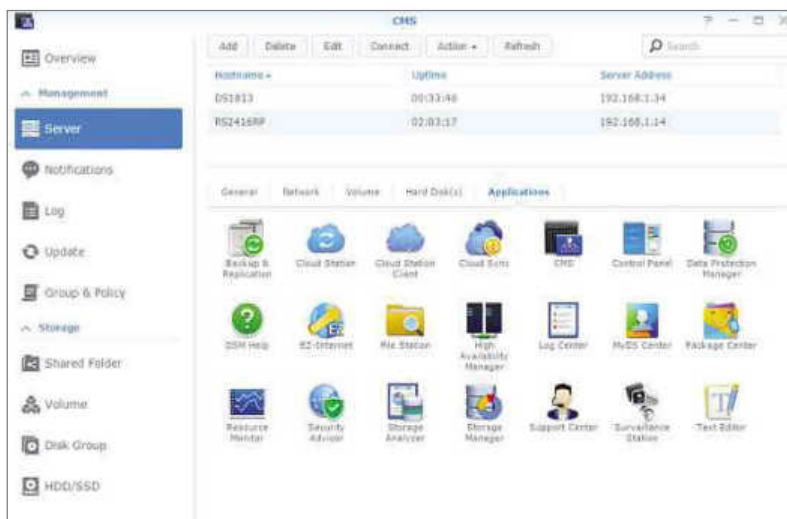
Choosing the right hard disks for your new NAS should be simple, but the sheer range of options and capacities is complicated. For duties such as file sharing and data backup, SATA drives are the perfect choice as they offer the best capacity-to-price ratio.

It's tempting to go for the cheapest ones, but bear in mind that options such as WD's Red NAS and Seagate's NAS SATA drives are only certified for use in appliances with up to eight

bays. For bigger models of up to 16 bays, you should choose products such as WD's Red Pro or Seagate's Enterprise NAS drives, which have enhanced vibration-compensation technologies and greater reliability.

SAS drives are more expensive, but they're the best choice for mission-critical apps and high-storage workloads such as databases or virtualisation, as they're optimised for performance. NAS devices that support SAS and SATA drives are

BELOW The CMS app can centrally manage multiple Synology NAS appliances

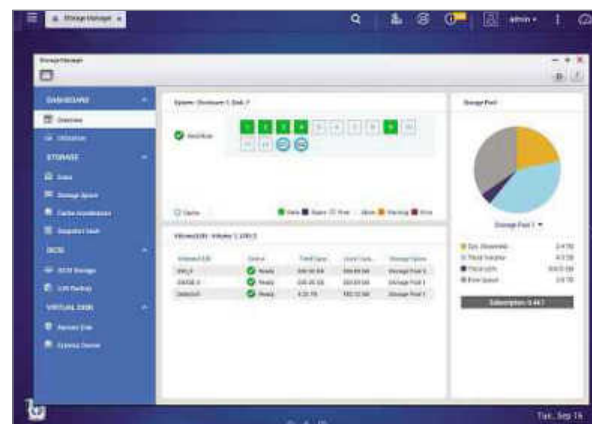
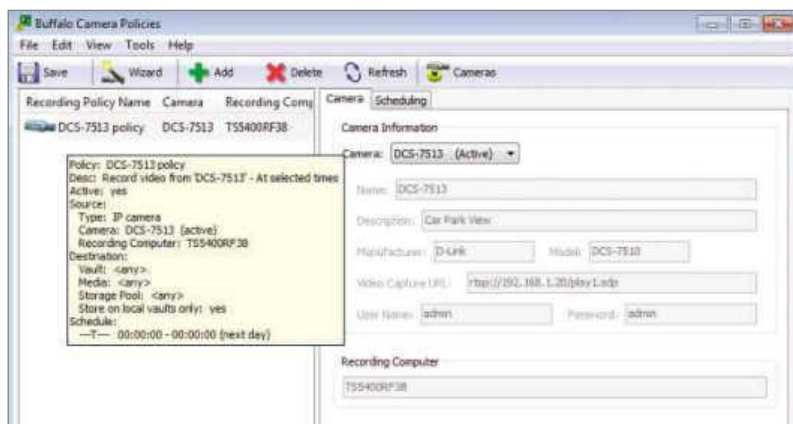


more common now, and we look at one surprisingly affordable appliance that supports high-speed 12Gbits/sec SAS 3 drives.

Thinking outside the box

Expect your business data to grow exponentially, so size your appliance to handle future capacity demands. A cheap little desktop NAS appliance may not look so clever a year or two down the line.

You can expand capacity by swapping drives out one at a time and replacing them with larger ones. Standard



RAID controllers will allow you to do this. However, the money spent on the original drives is wasted and rebuilds will take days, during which time a RAID5 array won't protect against another drive failure.

Pick an appliance with spare bays that can be populated with new drives as required. When there's no more room left inside, you may want to expand outside, so consider those with expansion ports that accept additional external disk shelves.

Chose your connection interface carefully – it may suffer a performance hit if you expand an existing RAID array into the shelf. SAS is the best choice, and those that have dual ports allow disk shelves to be daisy-chained over fault-tolerant links.

Apps galore

The race to have the most features isn't slowing down, with vendors packing a remarkable range of free apps with their software. Backup is high on their agenda, and many vendors provide file-syncing apps for desktop backup too.

Businesses concerned about using services such as Dropbox and Google Drive for sharing confidential data can now create their own private clouds. Most vendors still provide apps for these hosted services as well as including others that will run scheduled backups to cloud providers such as Amazon's S3 and Glacier, Microsoft Azure and many more.

With all your data being in one location, off-site backup is essential. Good products provide replication services between local and remote appliances, and those that support the rsync protocol will do it with any compliant appliance.

If you're deploying NAS appliances to multiple locations, you'll need to manage them and, consequently, you should look for those that have central management services. Some offer a cloud portal that the appliances link up with, whereas others provide apps that communicate remotely with registered devices.

What's in your NAS?

Don't skimp on processing power, since this will have a direct impact on network performance. For heavy workloads and a large userbase, consider those appliances with Intel Xeon E3 or Core i3/i5 CPUs as they have the muscle to cope.

Intel's Atom C2000 SoC (system on a chip) series is a good choice for medium workloads, whereas CPUs such as Intel's elderly Atom D2700 are best suited to light duties. Memory is also important and nothing less than 2GB should be considered. This will be eaten up quickly if you load a lot of apps on the appliance, so make sure it can be upgraded.

The recent theft of a storage device from Lloyds' data centre will have many businesses worried about data security. If you're one of them, you should select an appliance that can encrypt volumes and shares. Also, choose a CPU with an embedded AES-NI encryption engine. The Atom D2700, for example, doesn't have this engine, which means that performance on encrypted volumes will be painfully slow.

Most appliances come with a minimum of two Gigabit ports, but

ABOVE LEFT Buffalo provides NovaBackup software so you can secure your data to its NAS appliance

ABOVE RIGHT Qnap's 2U rack appliance supports SAS 3 drives and comes with mSATA cache modules

"Intense competition in the NAS market is good news for SMBs: prices are at an all-time low, and features just keep getting better"

BELOW Qnap's new Qcenter app lets you manage all your applications from one console

prices for 10GbE are now low enough to make it a viable option for SMBs that want even more performance. Some come with dual 10GbE ports already included, or you can pick one with PCI Express expansion slots that allow you to add adapter cards when you feel the need for speed.

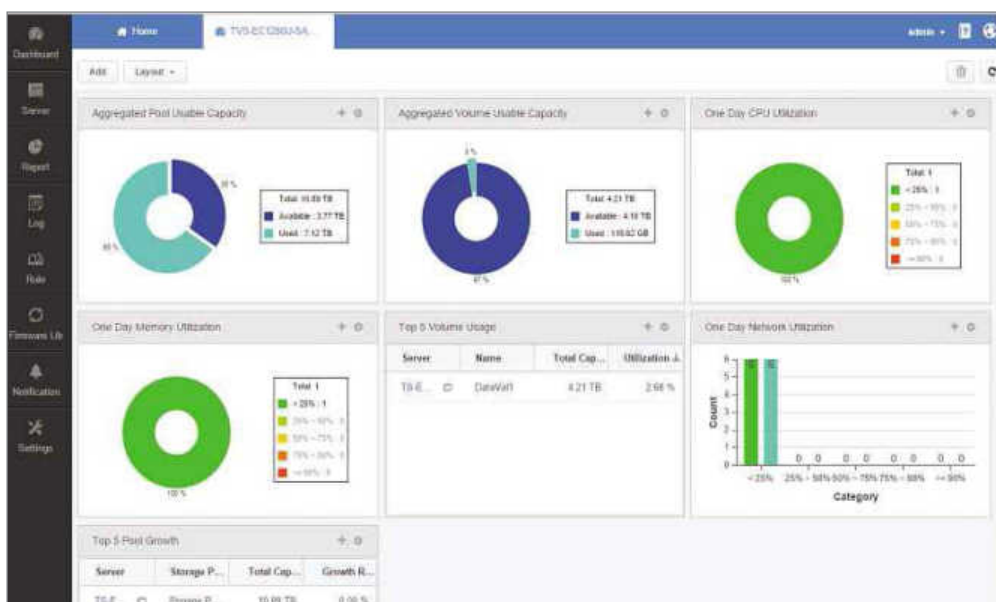
Snap happy

A recent feature that will appeal

to businesses looking for fast data recovery is Btrfs. Appliances that support this will allow you to create multiple instant snapshots of NAS and IP SAN volumes, with some of them running as often

as every five minutes for near-real-time protection.

Intense competition in the NAS market is good news for SMBs: prices are at an all-time low, and features just keep getting better. The appliances we have selected for review here offer a wide range of features with varied prices to suit every pocket, so read on to see which NAS appliance will best solve your storage problems.





Buffalo TeraStation 5400R

A high capacity at a low price, but inevitably you're getting basic features and average performance

SCORE ★★★★★

PRICE 12TB, £888 exc VAT
from lambda-tek.com

Buffalo's TeraStation 5400R certainly scores when it comes to value for money: despite our review model costing less than £900, it includes 12TB of raw storage. Business-class features aren't as advanced as the competition, but they do include support for NAS and IP SAN operations, plenty of RAID choices and IP camera surveillance.

What you're not getting is phenomenal speed. The 5400R lacks punch in the hardware department because it's endowed with an ageing 2.13GHz dual-core Atom D2700 and 2GB of DDR3 RAM, which can't be upgraded. You can't buy a diskless model, either, and have to buy replacement drives from Buffalo.

Installation took only two minutes: the appliance came out of the box with its four 3TB WD Red SATA drives preconfigured in a RAID5 array. Buffalo's NAS Navigator 2 utility worked fine on a Windows 10 desktop, where it provided quick access to the appliance's web interface and a handy drive-mapping service.

Before configuring storage, it pays to get acquainted with Buffalo's



logical volume manager (LVM). The 5400R comes with LVM disabled on its RAID5 array, so it will support NAS shares or an IP SAN volume, but not both.

LVM allows multiple NAS and IP SAN volumes to exist in the same array, but all pre-existing shares will be deleted when it's enabled. Disabling LVM later on will also delete all current shares and IP SAN volumes.

Buffalo states that LVM has a negative impact on performance, but we saw no evidence of this happening during our tests. On a non-LVM volume, a 25GB file copy to a mapped NAS share saw sustained read and write speeds of 111MB/sec and 80MB/sec, while our 22.4GB backup test copy delivered 62MB/sec.

Creating an IP SAN on our non-LVM volume deleted all shares, but there are security measures in place to prevent rash changes: the TeraStation sensibly asked us to enter a four-digit code before it went ahead with the operation. Performance matched our expectations, with Iometer reporting equal raw sequential read and write speeds of 112MB/sec for our iSCSI target.

Swapping to an LVM-enabled volume allowed us to create NAS shares and IP SAN volumes without impacting performance. Our NAS file

ABOVE The appliance came out of the box with its four 3TB WD Red SATA drives in a RAID5 array

copies returned the same speeds – as did Iometer when run on a new iSCSI target.

We were less impressed by Buffalo's Surveillance Server software, in part because it runs on a Windows host and only uses the appliance as a recording vault. It manages IP camera recording schedules and has a Video Manager tool for viewing them, but we had to load it on a Windows 7 system as it failed to run on Windows 10.

Backup features include one-way replication to other TeraStations for off-site storage. The 5400R can also manage scheduled jobs for copying data from local shares to other shares that have the Backup option enabled, which allows them to be used as destinations.

Buffalo's WebAccess let our users access permitted shares remotely via a web browser using Buffalo's cloud

portal, but it's not as slick as the cloud services offered by Qnap and Synology. The 5400R also supports Amazon S3 accounts, but we found it only syncs the contents of a single share to one

S3 bucket, and can't run scheduled backup tasks.

Whereas most of the competition provide built-in file syncing apps for workstation backup, Buffalo includes a ten-user copy of NovaBackup Business Essentials 14.5. We had no problem running scheduled backups of our Windows 10 desktops, and you can upgrade to the latest version – 17 – for a reduced fee of £35.

The TeraStation 5400R doesn't come close to Qnap or Synology for business features and performance but it is good value. SMBs looking for a big chunk of cheap network storage for simple file sharing and backup will find the TeraStation 5400R a worthy choice.

SPECIFICATIONS

1U rack • 2.13GHz Intel Atom D2700 • 2GB DDR3 RAM • 4 x 3TB WD Red SATA hot-swap hard disks • supports RAID 0, 1, 5, 6, 10, JBOD • 3 x USB 3 • 2 x USB 2 • 2 x Gigabit Ethernet • Buffalo Surveillance Server (1 x camera licence) and NovaBackup Business Essentials 14.5 (10 x licences) • 3yr standard warranty

“Swapping to an LVM-enabled volume allowed us to create NAS shares and IP SAN volumes without impacting performance”

LEFT Buffalo's web console uses a simple switch system for activating the various storage features



Netgear ReadyNAS 716X

Good 10GbE performance and classy snapshot data protection, but the price is tough to swallow

SCORE ★★★★★

PRICE Diskless, £1,840 exc VAT from broadbandbuyer.co.uk

Small and medium-sized businesses concerned with data protection should check out the ReadyNAS 716X, which offers a five-point safety net. Along with support for Netgear's versatile X-RAID2 arrays, it adds real-time antivirus scanning and private cloud backup, mixes in copy-on-write data protection and tops it off with unlimited snapshots.

The 716X comes with 10GbE enabled out of the box and has not one, but two 10GbBaseT ports, as well as dual Gigabit. There's room to grow, too, because you can use the three rear eSATA ports to connect Netgear's EDA500 five-bay expansion boxes, which are certified for 6TB drives.

Deployment takes minutes: Netgear's ReadyCloud web portal discovered our appliance and helped us set up a single X-RAID2 array using six 1TB SATA drives. Once it was registered to our ReadyCloud account, we could remotely manage it wherever we were.

Declaring users to ReadyCloud allowed them to remotely view, add or delete files and folders from the portal. They could also copy files to the appliance directly from their desktop by dragging them into the portal's Browse page.



Netgear was the first major NAS vendor to switch from EXT4 to Btrfs and its unlimited snapshots. You'll meet these during share or iSCSI LUN creation: there's a Continuous Protection checkbox where you request hourly, daily or weekly snapshots and leave the appliance to manage them.

Recovery options are another strong point. We made snapshots visible to users so they could restore their own files and we could recover files, directly from the web console. Snapshot rollback is extremely fast, enabling us to delete 22.4GB of data from a share, run a rollback from the latest snapshot and have everything back in only six seconds.

NAS performance is excellent: using a direct 10GbE connection to an HP ProLiant DL380 Gen9 server saw drag-and-drop copies of a 25GB

test file return sustained read and write speeds of 310MB/sec and 280MB/sec respectively. General backup speeds are equally good with our 22.4GB folder, packed with 10,500 small files, copied down at a fast average of 252MB/sec.

IP SAN performance was a mixed bag: Iometer reported raw read speeds of 1,114MB/sec, but only 532MB/sec for writes. This became more noticeable with a dual 10GbE MPIO link as read speed nearly doubled to 2,135MB/sec, whereas writes only stepped up to 700MB/sec.

We advise caution in dealing with Netgear's antivirus app, as its real-time scanner hurts performance. With it enabled, the backup test copy speed dropped by 44% to 141MB/sec.

The Anti-Virus Plus app provides a scheduler for regular out-of-hours scans on selected folders, but note the real-time scanner must be enabled to use it. We circumvented this by declaring all folders as exempt from real-time scanning, although it's hardly an elegant solution.

Furthermore, cloud backup apps are thin on the ground. Despite the 716X supporting Netgear's own Vault service, there are no

apps for providers such as Amazon or Microsoft Azure. Dropbox is natively supported, however, and we also used the ReadyCloud client on a Windows 10 desktop to sync local folders with

the appliance in real-time.

Netgear does offer a surveillance app, but compared with Synology's version, it's short on features. That said, you can create simple recording schedules and tie in with the camera's own motion-detection triggers. No licences are included, however, and a four-pack licence costs around £140.

The Netgear ReadyNAS 716X is too expensive for our taste, especially given that a six-bay Qnap TVS-671 with dual-port 10GbBaseT card would save us more than £800. General features aren't great either, although the unlimited snapshots and fast recovery both help claw back points – and it can't be faulted for NAS performance.

SPECIFICATIONS

Desktop chassis • 2.5GHz Intel Xeon E3-1265L v2 • 16GB ECC DDR3 RAM • 6 x hot-swap LFF/SFF SATA drive bays • supports RAID0, 1, 5, X-RAID2, JBODs • 2 x USB 3 • USB 2 • 2 x Gigabit Ethernet • 2 x 10GbBaseT • 3 x eSATA • internal PSU • 192 x 288 x 259mm (WDH) • 5yr RTB warranty

ABOVE You can use the three rear eSATA ports to connect EDA500 five-bay expansion boxes

“The 716X comes with 10GbE enabled out of the box, and has not one but two 10GbBaseT ports, as well as dual Gigabit”

LEFT The ReadyNAS 716X can be managed both locally and remotely, using the ReadyCloud portal



EXCLUSIVE

Qnap TVS-EC1280U-SAS-RP

Stunning storage features and performance with a price that's right for storage-hungry SMBs

SCORE ★★★★★

PRICE Diskless, £3,556 exc VAT from lambda-tek.com

Qnap's TVS-EC1280U-SAS-RP shoots for the enterprise, but delivers a remarkable range of features at a price SMBs will also find very palatable. This 12-bay 2U rack NAS has a fast 3.5GHz Intel Xeon E3-1246 v3 CPU teamed with 16GB of DDR3 RAM, and it supports SAS and SATA drives, yet a diskless system costs £3,556 exc VAT.

This is the first appliance from Qnap that supports 12Gbits/sec SAS 3 drives, and it has an embedded SAS 3 expansion port. You can connect up to eight of Qnap's new 16-bay and 12-bay disk shelves for a total of 140 drives and a maximum capacity of over 1.1PB.

Quad Gigabit ports come as standard, and two PCI Express expansion slots are available for multiple 10GbE upgrades. The price even includes dual 128GB mSATA modules for read or read/write cache duties.

The "RP" in the model name indicates that dual hotplug PSUs are also included. Ignore the BBU slot at the rear, though, because Qnap's C2F (cache-2-flash) battery backup feature still isn't available.

Installation using Qnap's discovery web portal took 15 minutes. It ran through installing the latest QTS 4.2

software and set up our quartet of 4TB WD SAS drives in a RAID5 array. Just released from beta, this QTS version adds a superb range of welcome new features.

The management web console gets a fresh design, while the Q'center app provides a central console for monitoring multiple NAS appliances. Using its customisable dashboard, we were able to create views of the appliance with graphs of storage pool and volume usage, plus appliance hardware utilisation.

Qnap's Virtualization Station is a favourite of ours as it lets us run other operating systems in virtual machines on the appliance. Previously, we had to dedicate network ports to each VM, but the new virtual switch does away with the need for this.

The Web File Manager app now supports direct links to cloud storage. We used it to view our Dropbox and Google Drive accounts and copy files directly between these and the appliance. The Qsirch text-based search app made light work of finding files on the NAS, and Docker support allows the appliance to host Linux apps in containers.

Cloud backup apps are in abundance, with options for Amazon S3 and Glacier, Microsoft Azure and

ABOVE You can connect up to eight of Qnap's new 16-bay and 12-bay disk shelves for a total of 140 drives



"Testing an iSCSI target on a 400GB HGST MLC SAS 3 SSD saw our database load produce a stunning uncached 86,000 IOPS"

Google Cloud Storage. Syncing services such as Dropbox and Google Drive is deftly handled by the Cloud Drive Sync app. We also created a private storage cloud and used the Qsync app on our Windows 10 desktops for syncing local folders in real-time with the appliance.

For testing, we slotted in an Emulex dual-port 10GbE-T adapter and linked to an HP ProLiant DL380 Gen9 server running Windows Server 2012 R2. NAS performance is very impressive, with copies of our 25GB test file delivering sustained read and write speeds of 465MB/sec and 426MB/sec.

The IP SAN performance is even better: a 500GB target returned a consistent 9.2Gbits/sec Iometer throughput for both read and write operations. With a dual 10GbE MPIO link, speeds increased to 17.3Gbits/sec and 15.4Gbits/sec.

The mSATA cache also delivered the goods. Running our Iometer SQL database load on an uncached target returned 21,000 IOPS, which then rose to 55,000 IOPS with

a read/write cache in action. But the good news doesn't stop there: testing an iSCSI target on a 400GB HGST MLC SAS 3 SSD saw our database load produce a stunning uncached 86,000 IOPS.

Apart from the noisy cooling fans, there's much to like about the TVS-EC1280U-SAS-RP. The top-notch features and performance, SAS 3 support, expansion potential and price tag makes this 2U rack NAS the perfect A-Lister.

SPECIFICATIONS

2U rack • 3.5GHz Intel Xeon E3-1246 v3 • 16GB DDR3 RAM (max 32GB) • 12 x hot-swap SAS3/SATA 3 LFF/SFF drive bays • supports RAID0, 1, 5, 6, 10, hot-spare, JBODs • 2 x 128GB mSATA modules • SAS 3 expansion port • 2 x PCI Express slots • 4 x USB 3 • 4 x USB 2 • HDMI • 2 x 400W PSUs • 3yr limited warranty

LEFT Syncing to Dropbox and Google Drive is deftly handled by the Cloud Drive Sync app





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Synology RackStation RS2416RP+

High capacity, good performance and data protection make this NAS a good choice

SCORE ★★★★★

PRICE Diskless, £1,399 exc VAT
from lambda-tek.com

Small and medium-sized businesses that are looking for a low-cost network backup repository with slick data protection features will find plenty to like in Synology's RackStation RS2416RP+. This 2U rack NAS is yet another of Synology's ever-expanding business range to support Btrfs, allowing it to provide snapshots and uncomplicated data recovery.

It has 12 SATA drive bays and can be expanded further using one Synology RS2414+/RS2414RP+ 12-bay disk shelf. There is a catch, though: the carriers in the head unit are big enough for 8TB Helium drives, but the disk shelf is older and its carriers only accept the slimmer 6TB drives.

The RS2416RP+ also comes with 2GB of DDR3, upgradable to 6GB using the spare slot. The four quiet hot-swap cooling fans are a neat touch, but the miniscule motherboard doesn't have a PCI Express slot, so it's not possible to upgrade to 10GbE.

Installation took only 15 minutes as Synology's discovery web portal found the appliance and installed the latest DiskStation Manager (DSM) software for us. With four 4TB WD SATA drives loaded, we chose the default Synology Hybrid RAID (SHR)

option, which allows drives of different makes and sizes to be used in the same array.

Synology's DSM Web Console is well designed and snapshots are configured from the Data Protection Manager (DPM) app. For NAS shares, it's important to select the data integrity protection option: you can then use DPM to create on-demand or scheduled snapshots and decide how many versions to keep.

They're easy to use and snapshots can be applied to file-level – but not block-level – iSCSI targets. Synology also offers a Snapshot Manager utility to take application-consistent snapshots of IP SANs, both in Windows and VMware environments.

Recovery using DPM is lightning-quick – we restored 50GB of deleted content in a share from its latest snapshot in under 20 seconds. Even better, you can make snapshots visible so that users can restore their own files or use the File Station app to browse snapshots and download or email files directly from DSM.

Snapshots provide only local data protection, meaning you'll need essential off-site backup. Synology's Backup & Replication app provides a wealth of features. We replicated data to other rsync-compliant appliances and to our Amazon S3 cloud account, and Synology also provides apps for

ABOVE Synology's RS2416RP+ has 12 SATA drive bays and can also be expanded further



"Synology's Cloud Station lets your users sync local files and folders in real-time from their desktops or mobiles"

Amazon Glacier, ElephantDrive and iDrive.

Want a private storage cloud? No problem, as Synology's Cloud Station lets your users sync local files and folders in real-time from their desktops or mobiles. Install the Cloud Sync app and you can link up with third-party providers such as Google Drive, Dropbox, OneDrive and Amazon Cloud Drive.

We tested the Surveillance Station 7.1 beta and rated it highly for its unbeatable IP camera monitoring and recording features. It supports thousands of camera models and its auto-discovery spotted our D-Link cameras and set them up with recording schedules.

The appliance delivered good real-world NAS speeds with a 25GB file copy returning sustained read and write speeds of 109MB/sec and

108MB/sec. Our 22.4GB backup test folder, with its 10,500 small files, was also copied down at an impressively fast 87MB/sec.

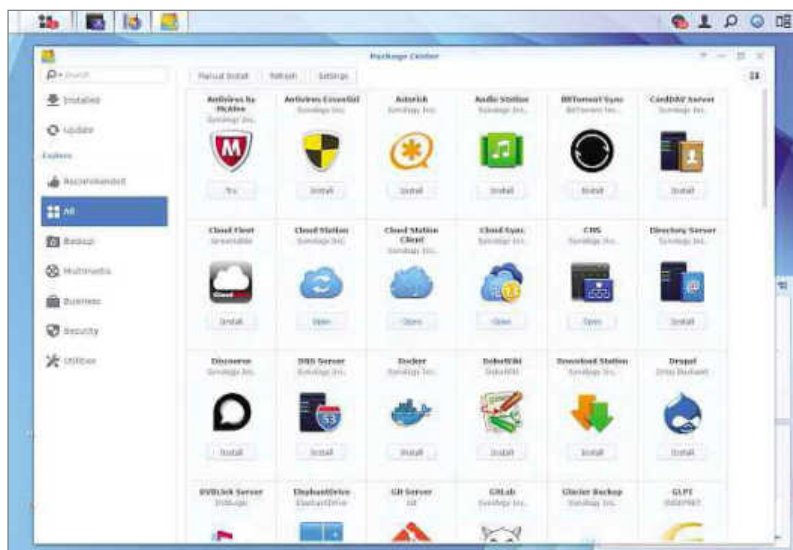
The Atom's integral AES-NI encryption engine delivered the goods, with our 25GB file copied to an encrypted share at 88MB/sec. IP SANs speeds are good too, with Iometer reporting read and write rates of 113MB/sec and 109MB/sec for a 500GB target, increasing to 226MB/sec and 201MB/sec over a dual Gigabit MPIO link.

Those small and medium-sized businesses that don't want optional 10GbE upgrades will find that the RS2416RP+ offers a superb range of storage features at an affordable price. Along with good performance, its cloud support won't be bettered and its snapshots provide valuable data-protection services. **DAVE MITCHELL**

SPECIFICATIONS

2U rack chassis • 2.4GHz Intel Atom C2538 • 2GB DDR3 RAM (max 6GB) • 12 x LFF/SFF SATA hot-swap drive bays • supports RAID0, 1, 5, 6, SHR, JBOD, hot-spare • 4 x Gigabit Ethernet • 2 x USB 3 • 2 x USB 2 • InfiniBand expansion port • 2 x 500W hotplug PSUs • 3yr limited warranty

LEFT Synology's DSM software provides an unbeatable range of free apps



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Netgear ProSafe XS728T

A high port density, plenty of features and top value make this 10GbE switch ideally suited to SMBs

SCORE ★★★★★

PRICE £2,039 exc VAT from
lambda-tek.com

Netgear is on a mission to put affordable 10GbE switching solutions into the hands of SMBs, and the latest ProSafe XS728T shows it means business. This slimline 1U chassis puts 28 10GbE ports on the table at a price no other vendor will get close to.

As the flagship of Netgear's ProSafe Smart Managed Switch family, the XS728T has 24 fixed 10GBaseT ports and augments them with four SFP+ fibre ports. There are no dual personalities here, as the SFP+ ports are dedicated and can be used alongside all 24 copper ports.

It's designed for small or medium-sized businesses that want high-performance core switching duties, or larger businesses looking for an affordable aggregation solution. With many of the latest NAS devices now 10GbE enabled, it's also an ideal solution for linking up a fast storage network.

At its foundation, the XS728T is an L2 switch with basic L3 routing capabilities. Called "Layer 3 Lite", it supports IPv4 and IPv6 static routing, VLAN routing and ARP, but not router

discovery using IRDP (only the older 12-port XS712T supports this).

Unlike the entry-level XS708E (pcpro.link/255netgear), this switch can be fully managed via a web browser. Netgear also includes its Smart Control Center discovery software, which provides quick access to the web console, along with IP address setup and firmware and configuration download facilities.

Smart Control Center ran fine on our Windows 10 desktop, but we found that the switch's web console doesn't currently support Microsoft's Edge browser. We could log in to the switch, but Edge wouldn't display any details or allow us to access the menu tabs.

We had no problems with Firefox, Chrome or Internet Explorer, though, in which we found the web console to be well designed and easy to use. It opens with an overview of the switch hardware, along with system temperatures and the status of the four surprisingly quiet cooling fans.

We could see the status of system memory and the CPU, view a graph of CPU usage and switch to a device view with coloured port icons showing their connection status and speed. The switch's cable tests tell you whether they're functioning correctly or have an electrical fault, and it will give an estimate of the cable length for 10GbE links.

ABOVE The ProSafe XS728T has 24 fixed 10GBaseT ports and four SFP+ fibre ports



The web console furnished us with lists of switch and port statistics for switch monitoring, and it can send log data to a syslog server. For SNMP, we used Paessler's PRTG Network Monitor to keep an eye on the switch and port status plus traffic throughput on each port.

Ports can be placed in up to eight static or dynamic link aggregation groups (LAGs) for high-speed and fault-tolerant trunks. Layer 2 features are extensive, with support for port, MAC and protocol-based VLANs. The switch can create VLANs for VoIP traffic and the Auto-VoIP option identifies SIP, H.323 signal and SCCP traffic and automatically prioritises it.

The quality of service (QoS) controls allow you to assign one of eight priorities to each port, with a minimum bandwidth applied to each one. The switch supports 802.1p and

can detect these fields and map the packets to the required priority queue.

Security is on the money: Radius and TACACS+ can be used to tighten up admin access.

Port authentication using 802.1x is supported and unauthenticated users can be passed to a guest VLAN with limited network access.

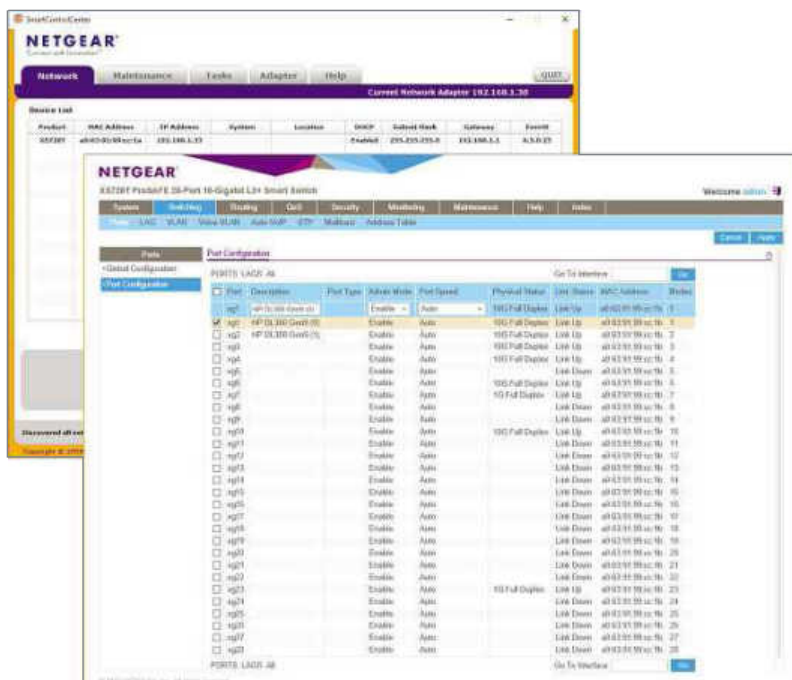
The switch is easy on the power supply. We measured it drawing 75W, with the load increasing by around 4W per 10GbE connection. Green Ethernet technology is supported, meaning that the switch will reduce power on ports where short cables are detected and, if the Energy Efficient Ethernet (EEE) feature is enabled, it will reduce power consumption on ports with low utilisation.

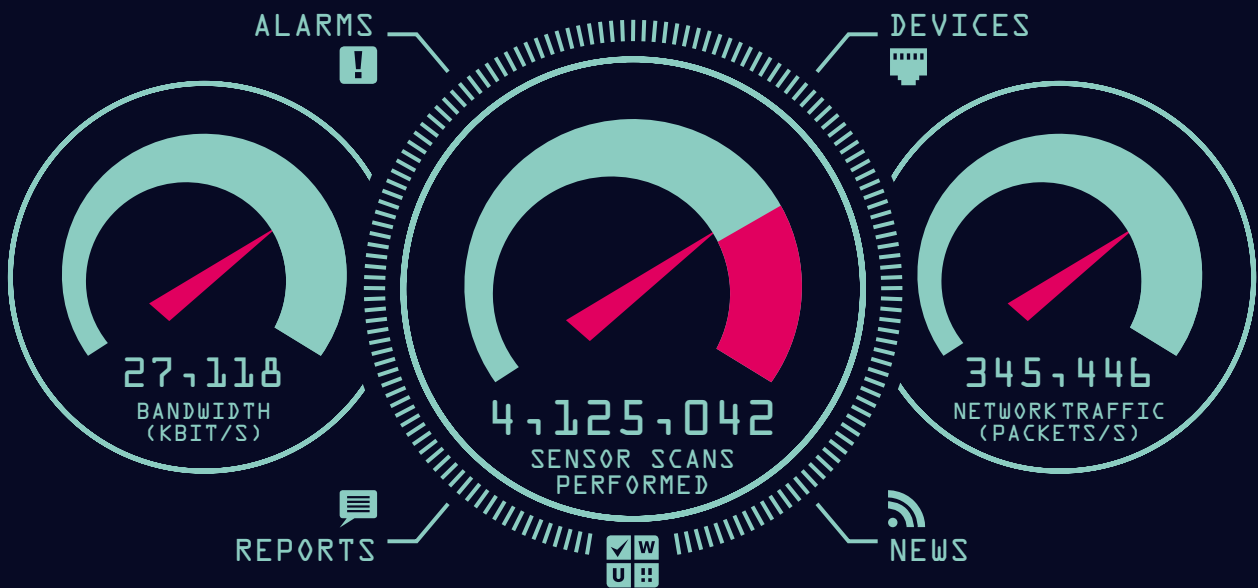
As the first 28-port 10GbE switch on the market, the XS728T sets a high standard for those vendors that dare to follow in its footsteps. SMBs looking for a path into high-speed networking simply won't find better value anywhere else. **DAVE MITCHELL**

SPECIFICATIONS

1U rack chassis • 24 x 10GBaseT • 4 x dedicated 10GbE SFP+ • USB 2 • 560Gbits/sec backplane capacity • 512MB system memory • 3MB packet buffer • 16K MAC addresses • internal PSU • Netgear Smart Control Center software • web browser management • limited lifetime warranty

LEFT The Smart Control Center is well designed and easy to use





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Plustek eScan A150

An innovative network desktop scanner, but slow speeds make it best suited to light office duties

SCORE ★★★★★

PRICE £379 exc VAT
from bmisolutions.co.uk

Standalone network scanners usually carry a price premium, but Plustek's eScan A150 bucks the trend with a modest £379 price tag. The embedded Android OS makes it totally host-independent, and it offers integral wired and wireless networking, plus support for a wide range of scan destinations.

Installation was simple. We just plugged it in, connected it to our wired network and used its 7in colour LCD touchscreen to set basic details such as time and language. Setting up a wireless network connection is also a cinch: we opened system settings, viewed the available networks and chose which one to join.

It took us a while to get the hang of the A150 because everything is configured at the touchscreen. We've grown used to network scanners, such as Brother's ADS-2600We, that use a separate app or web portal for remote device and scan setup.

General operations are also different: you scan your documents first and view them on the built-in screen, where you can crop or resize selected pages and change brightness and contrast. When finished, you tap the save button and select a destination from the menu.

The screen can display up to six destinations, including a USB stick, PC, email, FTP/SFTP server, an SMB network share and mobile device. Cloud options are good too, with Plustek supporting Google Drive, Dropbox, Box, Evernote and SharePoint.

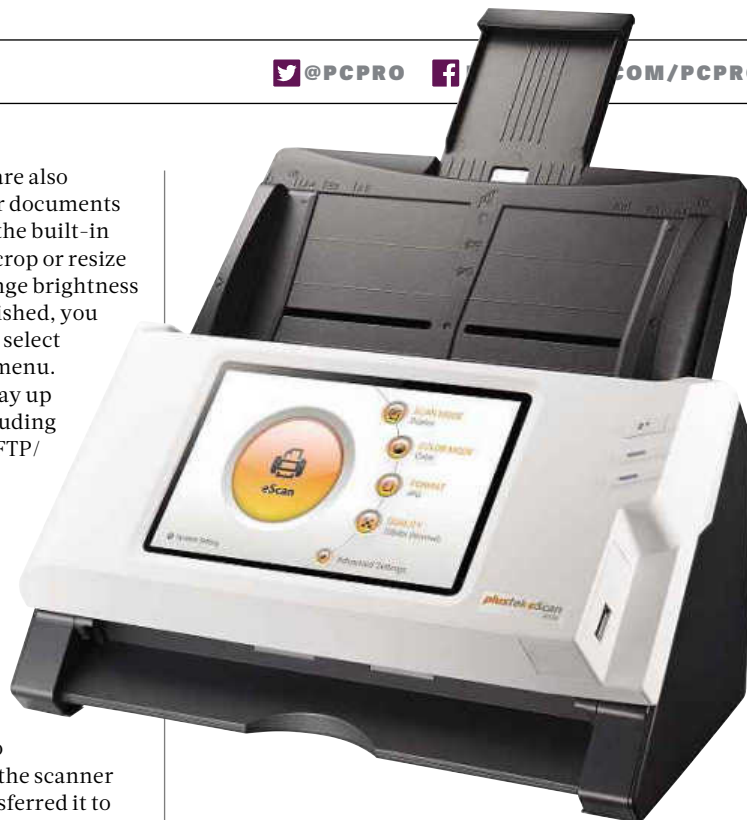
To scan to a PC, we used the touchscreen to copy a stored app from the scanner to a USB stick, and transferred it to our Windows 10 machine. The app can then place incoming scans in a specific folder, print them directly and link up with the bundled ABBYY FineReader and Presto! PageManager utilities for text recognition.

Once the app had been installed, the scanner automatically appeared as an entry in the PC destination list. The same applies to mobiles – after loading Plustek's eScan iOS app on our iPad, it popped up in the scanner's menu as a new mobile destination.

Cloud scanning was painless. We used the screen menus to link it to our Dropbox and Google Drive accounts and to password-protect access. Scan

processes can be turned into a swift two-step manoeuvre by saving scan jobs for repeated use.

Four soft buttons on the main screen let you choose



ABOVE The eScan A150 has a 7in colour LCD touchscreen

resolution, colour and output format prior to scanning. The advanced settings screen allowed us to choose resolutions up to 600ppi, TIFF, JPEG, PNG, PDF or multi-page PDF formats, and enable features such as hole-punch removal, blank-page skipping and water-marking.

However, the scan speeds are poor. The A150 can only achieve 15ppm for mono and 4ppm for colour at 200ppi.

We asked it to send a 20-page sheaf of bank statements directly to a PC as a PDF. The duplex mono scans delivered 11ppm at 200ppi and 7.5ppm at 300ppi. Colour duplex scans dropped the speeds to 3.6ppm at 200ppi and only 2ppm at 300ppi.

The quality is high, but run the calibration process first or scans will look washed out. Mono and colour scan quality at

200ppi is good enough for archiving, and PageManager's OCR skills are beyond reproach. It had no problems with small receipts and bills, but there's no anti-skew feature. ID cards and credit cards could also be scanned, but only one at a time.

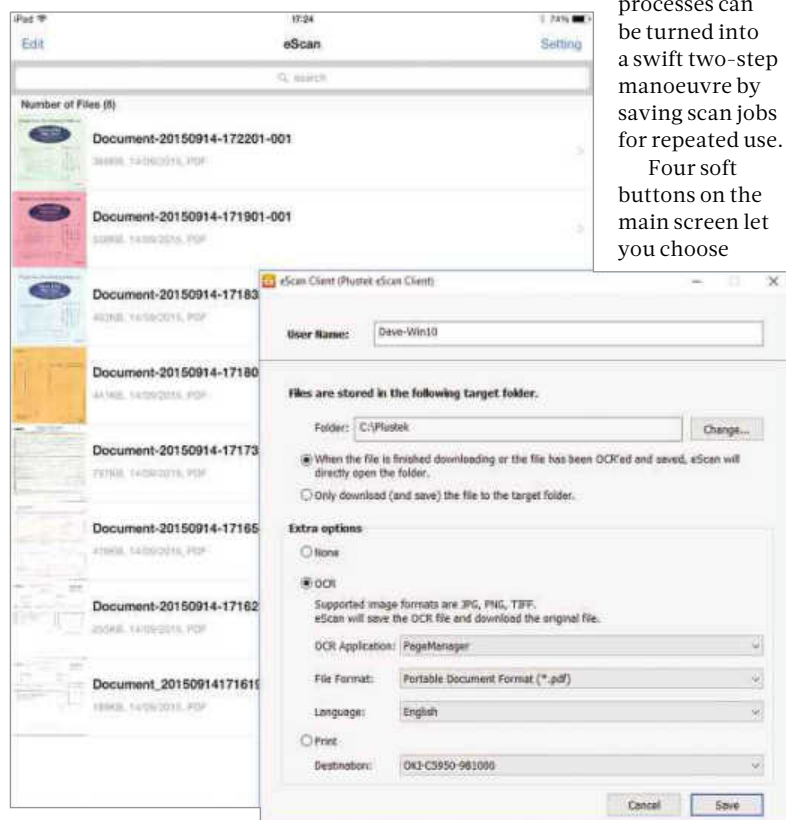
The A150 is easy to use, good value and produced high-quality output, but colour scans are just too slow for us to recommend it. **DAVE MITCHELL**

"After loading Plustek's eScan iOS app on our iPad, it automatically popped up in the scanner's menu as a new mobile destination"

SPECIFICATIONS

600ppi colour optical resolution • Android OS • 15/4ppm @ 200ppi mono/colour • simplex/duplex • 50-page ADF • 7in LCD colour touchscreen • quad-core 1.6GHz RK3188 Cortex-A9 CPU • 1GB DDR3 RAM • 10/100 Ethernet • 802.11an wireless • USB 2 • daily duty cycle, 1,500 • external PSU • Windows/Mac client • ABBYY FineReader 9 Sprint and Presto! PageManager 9 SE software • 318 x 170 x 189mm (WDH) • 1yr RTB warranty

LEFT Plustek's iOS app and Windows utility make scanning to mobiles and PCs easy





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Audio Station, Photo Station, Video Station and Media Server transform your Synology NAS into a centralised multimedia hub.

Where to Buy

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The electronics specialist
maplin

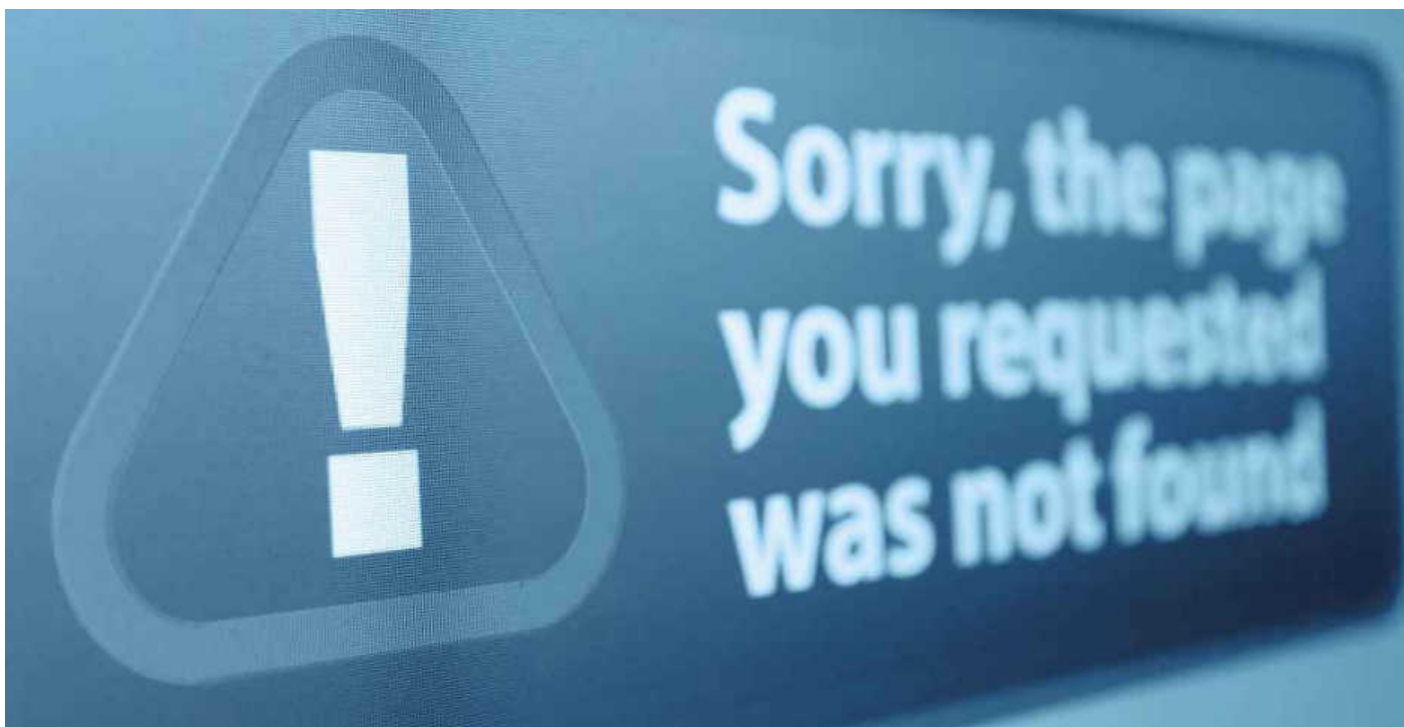
Synology apps available on

iOS



Synology's Media
Accolades





THE BUSINESS QUESTION

How effective is your website?

Take a long look at your site: is it stuck in the past? Is it fulfilling your company's marketing needs? **Nik Rawlinson** answers the tough questions

From a multinational PLC to a self-employed dog walker, your chances of drumming up work, winning new orders and building your business increase once you get online. It has never been easier, or cheaper, to promote yourself on the web.

But that's true for everyone, which means it's never been easier to fall behind your rivals, either. Even if your website fulfilled its purpose when you created it, you should now ask yourself some tough questions. Have your customers moved onto social media? How many visits are from phones? Is your marketing approach stuck in 2010?

"The start point is always 'what is it you're looking to get from your website?'" explained Marcel Cowan, director of digital marketing agency The Island. "We always recommend clients look at everything in the whole. It's about the customer

journey in the funnel. If you're a bar or a restaurant, normally you're looking to get people to book and show up, so we'd look at how we can drive people to the booking page and incentivise them to fill it in, and then make sure they turn up at the end once they've made that booking."

Getting it right starts with research, long before you start fiddling with design. Only when you know what you want to achieve is it possible to judge the site's effectiveness and work out how it can be improved. That largely relies on search-engine optimisation and analytics, and Cowan points to keyword tracking – how well you're performing against a certain search term – as an important indicator.

You can do this through Google Analytics, once it's been running long enough to have gathered a healthy batch of visitor data from your

domain. The most important metric to consider is "Average Position" for any keyword in the Audience | Acquisition | Search Engine Optimisation | Queries section. The lower the number, the better. If you see a change from, say, 4.8 to 3.2 over the course of a month, you're heading in the right direction.

■ An online shop window

Even if you're not making sales directly, a website is a window into your business. You need to treat it as a bricks-and-mortar business, like a supermarket might its premises. We've all experienced that moment of confusion when we pay our local supermarket a visit just after the stock has been rearranged. This isn't always to steer you past stock you wouldn't normally pass – more often, it's because research has shown that a shuffle would expose a wider range of more profitable lines and increase overall revenue.

You can judge the effectiveness of your site in much the same way, monitoring which pages are under-

viewed and rearranging the traffic to achieve optimum visibility. But how do you know which parts of the site work well and which are gathering cobwebs?

The obvious answer

is to track visitors with a tool such as Google Analytics, which adds a block of code to each page you want to track. This is a one-time operation if you're using a content-management system (CMS). If you run your site on WordPress, there are Google Analytics extensions in the plugin repository.

"Only when you know what you want to achieve is it possible to judge the site's effectiveness and work out how it can be improved"



Every time a page containing the embedded code loads in a browser, Google clocks the hit and records a wide array of data. This includes the identity of the page, the visitor's device resolution, browser type, geographic location, how they got to your page, and how long they spent on your site.

"It's all about the bums on seats, money through the till, ticket sales, email-address list increase," said Cowan. "The top layer of Google Analytics supplies you with the users and unique visits, but actually [what you need to be looking at is] setting up the goals and the funnel down, how much a specific keyword's climbed up the Google ranking, how many people have landed on the 'thank you' page after submitting the booking form or buying the product you want them to buy."

Hit count is perhaps the metric you should pay the least attention to when gauging a site's effectiveness. Things such as platform and device are far more important, as these can tell you how many visitors reach the site from a phone, and need a booking form optimised for small screens.

■ Making an impact

You need to keep two things in mind: how your visitor moves through the site, and how they see each page. Nowadays, it's not enough to consider how your site behaves on desktop, but how it appears to smartphone and tablet users too (see *The expert view*, below).

Google publishes advice on homepage design and site navigation at its developers.google.com site. The search company advises web designers to place the tasks it wants users to perform at the very top of the site. If you're selling car insurance, for example, put the form allowing

people to enter their number plate "above the fold". Don't waste that valuable space with special offers or "vague calls to action" such as "Learn more" buttons.

Menus should be short and sweet, says Google. "Mobile users don't have the patience to scroll through a long list of options to find what they want," the company advises. Reorganise your menu to as few items as possible, without sacrificing usability."

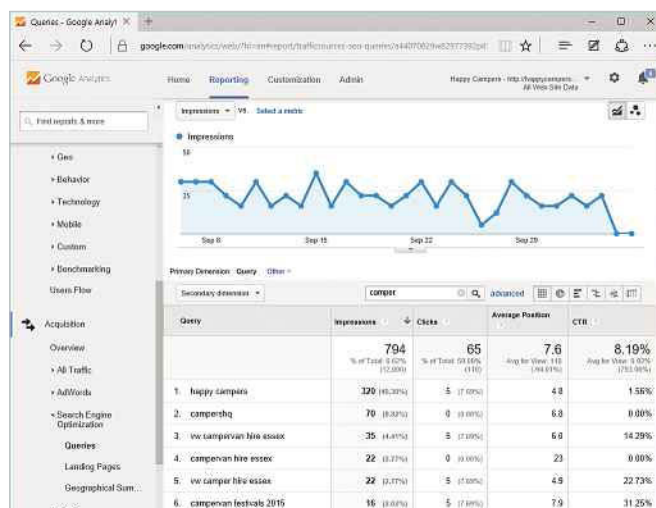
Use a responsive layout that is optimised for mobile, and don't mix and match. A Google study of website users in the US revealed that sites with a mix of desktop- and mobile-optimised pages were even harder to navigate than desktop-only sites. Likewise, users should never have to pinch to zoom to read content from your website. Likewise, product images on your site should be expandable.

■ Content really is king

Offering compelling content from your site is also critical. Ed Owen, PR and content manager for the Direct Marketing Association, believes that building trust through clear, honest copy, and that constant innovation and reinvention is paramount. He points to "listicle" articles as an example. Easy to write and shareable, they were popular a couple of years ago, but are falling out of favour and now draw fewer clicks.

"You need to keep finding new innovations and new reasons to click through by testing your copy and audiences," Owen explained. You can only do that if you build testing into your daily workflow.

"Some people say you should do A/A/B tests as well as A/B in case



ABOVE The lower Google Analytics' "Average Position" metric, the better your site's traffic

there's a quirk in the results," said Owen. "It's more of an investment upfront, but you'll get a better result down the line." Marcel Cowan agrees: gauging and improving a website isn't a short process. "I liken it to giving birth," he says. "You focus on giving birth to the baby, but you forget about the fact you've got to take care of the baby once it's here."

Change is rarely immediate: "It needs six weeks before you'll begin to see any kind of changes, [and really] you need to commit six months."

Success, therefore, comes through long-term effort and the process of monitoring your site's performance over time. What might work today may be outdated tomorrow. There's no easy answer, no universal solution – constant experimentation is the only way forward.

As Owen said: "If you can find an unusual and interesting approach, usually that will trump even the refinements you can bring." ●

"You need to keep two things in mind: how your visitor moves through the site, and how they see each page"



The expert view Paul Ockenden

What use is an effective website if only half of the intended audience can see it properly or interact with it?

Many sites are now seeing around half of their traffic coming from mobile devices, either phones or tablets, and just serving these visitors a copy of your desktop site is missing a big opportunity. Text and images might be too small to see without pinching and zooming, buttons too small to press with a finger tap and, even worse, you might have site navigation that relies on hovering a mouse – there's no such thing as hover on a touchscreen device.

Once upon a time you'd have created a special mobile website, often served up on m.domain.com but, these days, most sites adopt a technique called

responsive design. Using this, the website layout, styling and navigation can adjust to automatically work better on smaller screens. Two columns might become one, "window dressing" images disappear, and forms gain big, finger-friendly buttons. You can even adjust the order of the content: a restaurant might prioritise a location map and contact details for people on the move, and menus and booking forms for those perusing the site from an office.

Most modern web-design tools provide support for responsive design, often using frameworks such as Twitter's Bootstrap or ZURB's Foundation. For the site to be effective, you really should think of the different needs of people sitting comfortably at a desk compared to people on a bus, say, or walking down the street. What do each of these

people need from your company and, therefore, from your website?

You'll get an idea of how your site adjusts to smaller browsers by simply dragging the right-hand side of your desktop browser window and seeing how the site adapts. You might like to try this right now on alpr.com, and discover how the site accommodates different-sized screens.

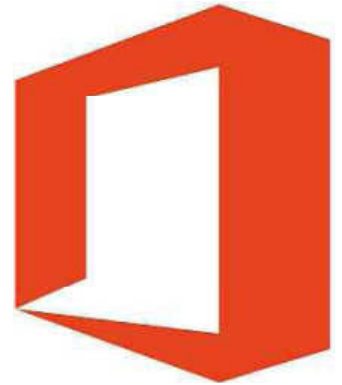
Better still, you can test your site using Google's mobile-friendly test tool, which you'll find at pcpro.link/255test. It will show you how your site looks on a typical smartphone, and give you some hints about how to improve the user experience.

Ultimately, you can't beat testing the site on real phones and tablets. For a well-resourced company this might involve a test lab; for those on a more limited budget, friends and family can be an asset.



Office 2016: How to collaborate easily

Alan Richards explores the new collaboration tools in Word 2016 and takes a look at Excel 2016's data-analytics features



The strapline for Office 365 is “takes the work out of working together”, but what exactly does Microsoft mean by this? Primarily, it's talking about collaboration, but aside from that, there are new and improved features waiting to be discovered. In this feature, we'll guide you through using the new collaboration tools in Word 2016, and take a look at both Skype for Business and the new data-analytics features in Excel 2016.

■ Outlook

Outlook 2016 benefits from a much-improved search facility, and promises to help keep your inbox clutter-free, thanks to automatic message filtering.

“Modern attachments”, which puts your most recently used files in a menu on the Outlook ribbon, help you send files more quickly. Better still, if the files are stored on OneDrive, you can share them directly, rather than having to email copies of the same document to multiple recipients. As a result, anyone who opens the file from the link in your message will always be working on the latest version, even if you make changes after clicking Send.

Office 365 Groups have been brought to the fore, with access through the Outlook 2016 ribbon to shared file locations, the group calendar, group OneNote notebook, membership details and more. Previously, it was only possible to access groups through Office 365 online, but this is more convenient because it integrates Microsoft's whole system of ring-fenced communications, documents and emails within the client.

■ Skype for Business

Skype for Business, Office 2016's Lync replacement, also focuses on collaboration.

It looks and feels very much like the regular Skype, but sticks with the familiar Lync contacts interface, rather than the more consumer-focused Skype contacts. The ability to search the Skype directory, as well as your organisation's Skype for Business directory,

is a significant enhancement. Skype for Business will default to your corporate list by default, only widening it out to the broader Skype network if you click the Skype Directory button.

You can send instant messages, call (both audio and video) and screen-share with your contacts from Skype for Business, even if they're using the consumer client.

■ Tell Me

You'll find a “Tell Me” box beside the menu in each of the Office 2016 applications. Clicking it opens a search box with a difference: it accepts plain English input and returns menu items that accurately answer your query.

The technology has been available in Office online for a while, but this is the first time we've seen it in the client apps. So, typing “how do I share my document” will pull up the Share command, “Send as email” and other sharing commands, as well as help and Smart Lookup links.

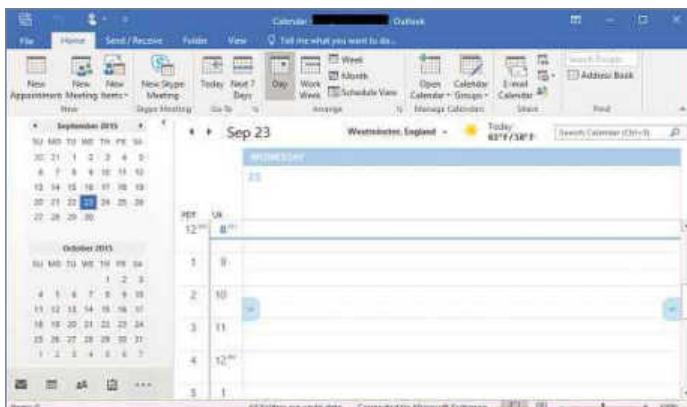
The Smart Lookup link is where it gets really interesting: clicking it opens up the Insights pane, which is populated with web-based resources (and not just Microsoft resources, but wikis, definitions and search results drawn from the web by Bing).

■ Excel

As well as inheriting the cross-suite features such as Tell Me, Excel 2016 sees the introduction of a number of new features centred on data analytics: six new chart types, a one-click forecasting tool, new Get and Transform capabilities, 3D map functionality and easier interaction with Microsoft Power BI.

With the new Get and Transform capabilities, you can pull in data from a wider range of external sources, including Access, SQL and Azure. This allows you to bring data into one location to create charts and perform analysis in a single client application.

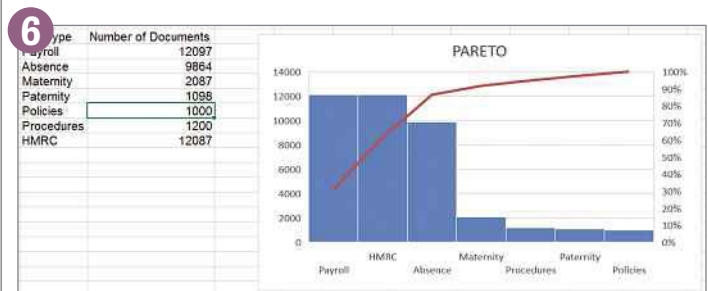
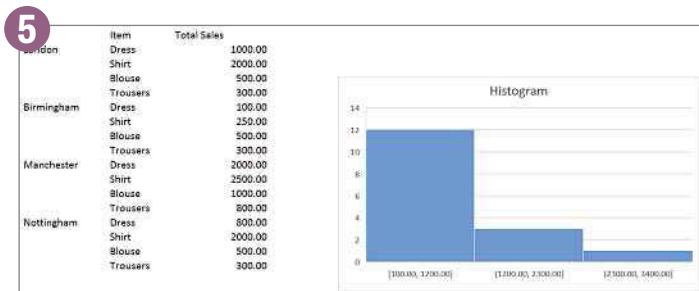
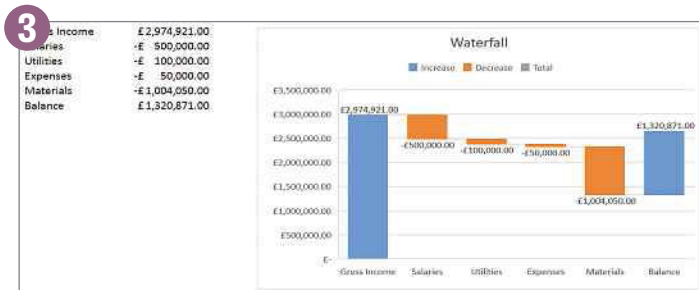
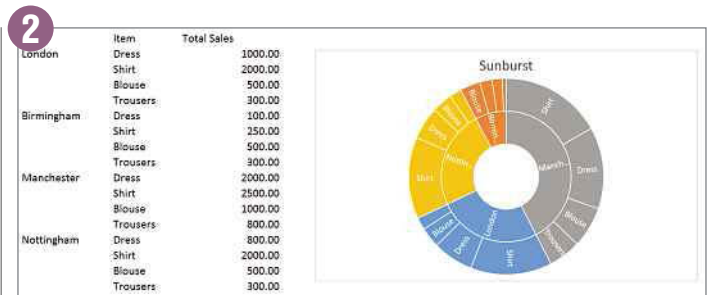
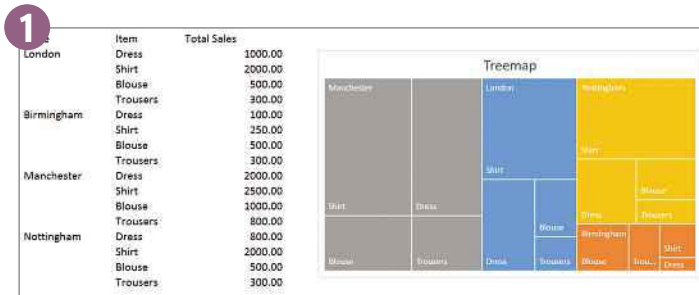
The new one-click forecasting tool uses time-stamped data to produce charts showing historical and forecasted data. For example,



ABOVE You can access group calendars through the Outlook 2016 ribbon



ABOVE Skype for Business sticks with the familiar Lync contacts interface



it's easy to turn a simple two-column spreadsheet showing monthly sales figures into a forecasting chart showing predicted sales for the upcoming months. Rather than relying on a Microsoft algorithm to handle the forecasting, Excel uses the industry-standard exponential smoothing algorithm (ETS) as its source.

The 3D map feature, formerly known as Power Map, is used to plot geographical data as a map, giving you the ability to zoom into the data for powerful data analytics when you're mapping geographic-specific data.

The six new chart types are probably the headline news, though. Each of them can be personalised using the regular customisation tools in Excel.

1 Treemap This type of chart shows a hierarchical view of large amounts of data, which other chart types would be unable to display in a meaningful manner. The data is presented in block format, and grouping allows you to easily view proportions within the hierarchy. As can be seen in this example, we have four items on sale in stores in four cities: London, Birmingham, Manchester and Nottingham. Using the treemap, we can immediately see that the Manchester store processed the most sales of each outlet and that, while the shirt was the bestseller there and in London and Nottingham, it was outsold by the blouse in Birmingham.

2 Sunburst Sunburst is very similar to the treemap chart, with each ring representing a level of the data hierarchy. Once again, we can gain a quick impression of the overall level of sales in each of the stores by comparing the size of the coloured sections, and the individual sales metrics that comprise each one by looking at the individual product-type segments.

3 Waterfall The Waterfall chart is ideal for showing a profit or loss dataset. The data can contain positive and negative values, and is plotted in different colours on the chart, giving a graphical representation of

the values. The top of each bar shows the plotted value, but the focus is on change over time, rather than current standing.

4 Box and Whisker Box and Whisker is very similar to the Waterfall chart type in that it can be used to track values, showing the fluctuations in graphical form. The layout is different to the Waterfall, though, as a chart of this type plots the values using simple lines, whereas the Waterfall chart shows blocks of data.

5 Histogram This chart type takes your data and shows the frequencies within the distribution. For example, here we see the number of products sold with each price range.

6 Pareto Excel groups this chart with the Histogram chart for a reason: it uses the same plotting technique, with each bar showing frequencies, but it also has an added line for the cumulative total percentage.

Formula and maths functions remain a staple of this release, among the most impressive of which is the new ink-based function tool. It lets you directly sketch out complex functions, using a finger on a touchscreen, trackpad or mouse, and have the Office 2016 applications convert them to their typed equivalents. This is a considerable time-saver, and far less complex than building them piecemeal using elements picked from the ribbon.

Excel 2016 also provides one-click publishing to Power BI, simplifying the process of sharing your work. Plus, with Excel online built into the Power BI service, it means that anyone you share your spreadsheets with will be able to fully view your formatted spreadsheets.

Cross-platform and device consistency

Office for iPad, iPhone, Android and Mac have all been released largely in sync with one another, allowing you to work on a wider range of platforms than ever before. On the whole, compatibility is

much improved: cloud-based storage allows you to jump between devices and platforms, and continue working on your documents.

However, there are some instances where the transition from one to another isn't perfect. The new charts in Excel 2016 are a case in point: use them in a spreadsheet created on a Windows-based PC, and they'll open just fine on any other PC running the 2016 app. Open them on a Mac, though, and they disappear. Likewise, import data from Facebook Graph using the Windows edition and, while Mac users will be able to see the results of your calculations, they won't be able to interact with them to perform further analysis.

A collaboration scenario

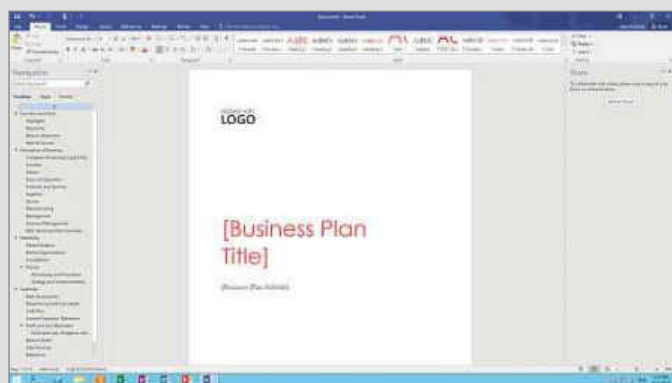
With the launch of Office 2016, Microsoft is ushering in what it hopes will be a new era of collaboration both at home and in the workplace. Microsoft's Office suite leads the productivity platform market, and is widely used in millions of homes and businesses around the world, but up until now, its collaboration features could have been better. Now, with the backing of Office 365 and the cloud technologies, in which Microsoft has invested heavily over the past several years, Office 2016 looks set to be a collaborative breakthrough product.

True document collaboration

Let's take a look at a simple scenario where Alan and his brother Bradley are starting a new company called Cloud Adoption. They're writing a business plan to put in front of their investor and have also enlisted the help of Sharon, an external business consultant, to give them the best

hope of winning the funding they need.

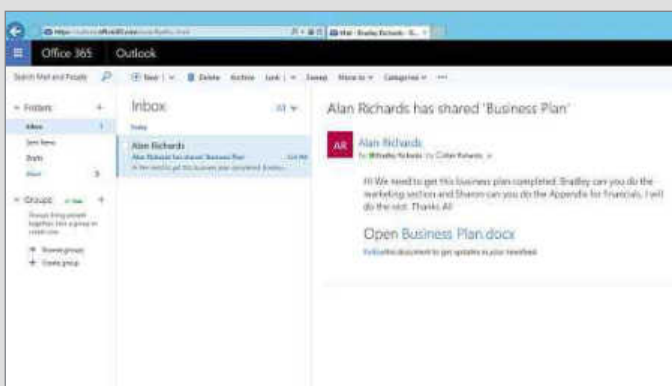
They have all signed up to a Microsoft Office 365 subscription to make sure they have the appropriate tools available to complete the tasks ahead.



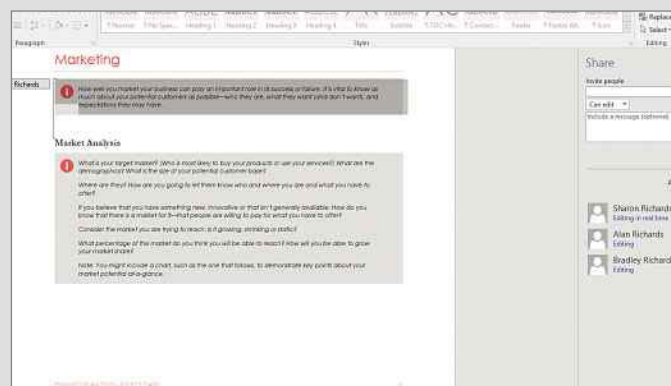
1 Clicking the Share button at the top of the Word interface opens the Sharing pane. This is the first step in setting up real-time collaboration with other users. The next is to upload the file you want to share to the cloud. Alan has various options to choose from when he saves his file. As he already has an Office 365 account, he can use OneDrive for Business or a SharePoint Online site to host the document.



2 The Sharing pane is now populated with both Bradley's and Sharon's email addresses, one of which is associated with the same Office 365 subscription as Alan is using. Alan has added a message asking them to complete their sections and set Word to ask for confirmation before changes are shared (as opposed to "always" or "never" sharing changes). Alan clicks the Share button and the names of the people are added.



3 Bradley and Sharon each receive an email containing a link to the shared document. Clicking it redirects them to Office 365, where they'll be asked for login credentials before they can gain access. Once logged in, it's up to them whether they work with the file online through the browser-based applications, or in the client app on their PC or Mac.



4 The document is now being edited by all three users simultaneously. You can see from the Sharing pane that Sharon is editing in real-time, which means she is using Word Online through her browser, while Bradley is shown as editing, but not in real-time, so he is using the Word client. The centre section of Word shows the insertion bar at the point where Bradley is currently working.

The collaboration features in Word 2016 are much improved over their predecessors, and are very simple to use. The same functionality is available in Excel and PowerPoint 2016. Working this way should help reduce the

number of attachments being sent around your business, and cut down on potential confusion – OneDrive will take care of versioning control while you focus on producing the best work possible.

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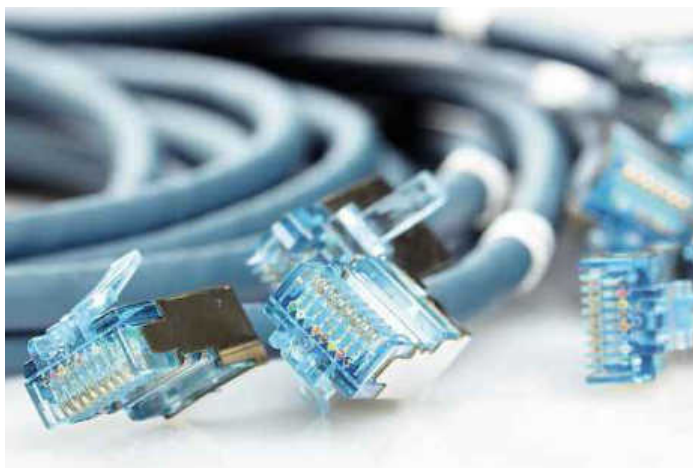
#appsworld

apps-world.net/world



Internet redundancy

Multiple discrete connections between your network and the outside world can reduce internet outages, says **Steve Cassidy**



■ I read that a single router can handle thousands of Wi-Fi clients – why would our small company need anything more?

First of all, those metrics for router “capacity” are not a guide to reliability. A huge router able to handle ten million users will still be offline if its sole connection to the internet goes down, and small routers carefully licensed to support only ten devices are extremely unlikely to have the software required to use more than one line. Routers in home and small-business internet contracts are supplied by the ISP, and the ISP isn’t likely to want to help you make use of someone else’s bandwidth when theirs is out of action.

■ Can’t we just replace our router with a more powerful one?

Yes, but that’s just the first step. You have to find out a few key facts about how your premises are supplied with internet connections, and then decide which approach will give you the best outcome when things go wrong. Causes of a loss of connection can be close to you (a digger in the road), or specific to your town (the phone exchange floods) or your region (your ISP’s local rack has a power outage or a software crash). Almost all business-grade ISPs will offer multiple lines (“channel bonding”), but this is not actually proof against most of the likely causes of a failure – the bonded lines are on the same telegraph pole and probably share the same physical connection in the phone company building. The ISP is also likely to then demand a more intrusive connection with your network, or to declare that some types of traffic (especially VPNs) won’t quite work as they did with a simple unbonded link.

■ Setting up a second router sounds complicated: how would everyone connect to our NAS drive and internet connection?

It sounds complicated because home and small-business routers are configured for a very narrow use case, mostly to keep people from fiddling. The internet connection provider will be thinking on your behalf, and working to the lowest common denominator – this sector wants to move towards a PAYG phone or electricity key meter style of internet use, and a limited, dim-witted router is their first line of defence. If you have a connection like this, then the only escape strategy is to put your border device (routers and firewalls are blurred here) in front of their router, so you can buy a device with a brain and a configuration that you control. This means you can try to get yourself a business-grade link and gently commission that before you decommission the home-type line.

■ That sounds like a big investment in enterprise-grade IT. We don’t want to spend that much.

That’s your decision, of course, but I would suggest you take time to work out how much outages

cost you, where they come from, and how quickly you can reasonably expect them to be repaired. A lot of ISPs will offer you a multi-line connection. This is a design in which the little copper wires that make up both data highways are laid along the same routes, through the same roadside junction boxes, into the same exchange, across the same frames and into the same equipment racks. It may sound like a cheaper solution, but look carefully at the failures that beset access to internet sites and services. Are they mostly physical? Are they about systems the ISP can’t control (that is, looked after by Openreach?), or are they mostly someone making a mess of a backbone router, somewhere in a data centre?

Enterprise-grade IT absorbed this issue

many years ago, already messing about with multiple gateways, segmented networks and inter-site bridges, routers and VPNs. The real developments in this field are actually at the smaller-business end of the market.

“Work out how much outages cost you, where they come from and how quickly you can expect them to be repaired”

■ What about using a MiFi repeater? I’ve seen firewalls with USB ports for 4G dongles too – isn’t this an easy fix?

If you assume that all your connection loss incidents are of the kind that involve over-ambitious diggers, incautiously reversed trucks or any of the other mayhem to which telecoms street furniture is vulnerable, then MiFi is an acceptable solution. However, these aren’t the only type of incident, nor are they especially common. Much more common these days is a service cutout due to reconfiguration, and that can affect an entire town or area, and also degrade service for mobile data users – all those types of traffic have been converged into the internet infrastructure, or use internet-style traffic-management techniques. So when you want to turn to your 4G modem for connectivity, chances are that many of your near neighbours will do the same. ●

Dual WAN 3G/4G failover points

■ While not perfect (*see above*), 3G/4G failover provides a “diverse” path to internet. Dual fixed-line circuits with different providers can still fail if a digger cuts both cables in road works.

■ 3G/4G SIMs are now available with IPv4 public static IPs via specialist providers. The SIMs allow inbound traffic, which means internally hosted services such as SMTP can continue to operate – just point the secondary MX record to 3G/4G public IP.

■ Public static IPs also allow Main Mode IPsec VPNs to continue to operate if secondary peer IPs are configured appropriately.

■ Depending on the router used to manage WAN failover, email alerts can be configured to notify IT staff of the primary internet problem.

■ In areas where 4G coverage is available, services such as VoIP can continue to run (QoS may need to be configured to reserve bandwidth, though).

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- Digital Signage
- EPOS



'Thank you for your support with this project, we've had a couple of sites already only able to trade fully due to the 3G backup, so we are very glad to have it.' - Peter Smith, IT Infrastructure Manager, Rohan Designs

*3G tariff includes 1GB monthly data, prices are monthly + VAT. Minimum contract term applies. Additional hardware may be required depending on your existing router's capabilities.



JON HONEYBALL

“The reality is that a modern phone can handle much, maybe even most, of the workload that you could do on a PC”

Microsoft's intriguing Windows Mobile announcements overshadowed Apple's news this month, and could offer the company a chance in the mobile market

It's hard to know quite what to make of recent Microsoft announcements: on the one hand, the company has announced a sweeping set of technologies that it has every right to be proud and excited about. But on the other hand, I'm not so sure: I wish I could be more certain they have “wow factor”. But maybe that will come once real hardware lands in my hands.

Let's start with the Windows Phone announcement. I'd normally just say “they announced a few” and move swiftly on, because Windows 10 Mobile is so horribly late to the party that they're not even there for the following morning cleanup – they've arrived on the wrong day, several weeks later. There's little sign that Android and iOS have any intention of giving up market share to any Windows 10 phone, irrespective of how shiny it is. The cold, hard reality is that Windows Phone is down in the small, single digits of market share. There's almost nothing short of a miracle that can shift that in an upwards direction. Indeed, I've even been heard to suggest that Microsoft simply not bother – too little, too late, and no-one gives a damn any more. And this would be true, except... the recent demonstration of the “Continuum” functionality is not just good showmanship, but really makes your head spin.

In essence, Microsoft has decided that its phone is not merely a phone but can be a

PC too. Now, to anyone with any sense, this shouldn't come as a surprise. I recently managed to dig up some 24 years of lab performance measurements we'd done for a client, and the change over that period was quite extraordinary. I still maintain that on a graph of “PC speed” against “user workload”, the PC speed line crossed over the workload line well over a decade ago. In other words, for the past decade or more there's been no real increase in meaningful workload – all that's happened is that our machines idle for a larger proportion of each day. So along comes a modern smartphone armed with a quad-core (or even more) processor, and it can handle the workload that any PC could do only a few years ago. This is actually one of my gripes about Office on tablets: why was it cut down compared to the version for desktop of 2010?

Anyway, I digress: this ability to plug a connection box into your Windows 10 phone and then connect a monitor, mouse and keyboard, with your phone running its own desktop of apps and tools, shouldn't come as a surprise. But it does, simply because there's always been that holy divide



Jon is the MD of an IT consultancy that specialises in testing and deploying hardware
[@jonhoneyball](#)

between phone world and PC world. The reality is that a modern phone can handle much, maybe even most, of the workload that you could do on a PC. No, I'm not talking about finite element analysis fluid modelling, or deep 3D CAD/CAM analysis of building structures, but for standard day-to-day tasks – such as web browsing, watching videos, email and Office applications – a phone has more than enough power. All it needs is a larger screen, keyboard, mouse/trackpad and possibly an Ethernet cable. Of course it's imperative that the phone still works like a phone while doing all this, as disconnecting yourself from the world while browsing on a big screen simply won't be acceptable.

Now the proof of the pudding will be in the eating, but I have high hopes for the functional capability of Windows 10 running on a phone that's delivered to a big screen. It's not simply mirroring the phone screen onto the big screen, but actually running an entirely separate display: apps will resize appropriately. This exploits all the work Microsoft has done building Metro apps that can sort themselves out on a wide variety of screen layouts and sizes. (I would apologise for calling them Metro, but to be honest I've lost track of what we're supposed to call them this week.)

This presents the really compelling possibility of keeping your entire computing world in your pocket, for mobile operation on the go and desktop docking when you get home, or for using hot-desk environments at work. I can easily see many users, both home and corporate, being seduced by it. Having a single point of failure isn't an issue, because everything will be backed up to the cloud, or to a set of corporate cloud servers.

My concern is this: will Microsoft non-negotiably guarantee that this will be supported for a minimum of five years or more? If it expects

BELOW The work Microsoft has put into making responsive apps will pay off in Continuum





Jon Honeyball
Opinion on Windows, Apple and everything in between – **p110**



Paul Ockenden
Unique insight into mobile and wireless tech – **p113**



Tom Arah
Can Adobe Stock photography save you money? – **p116**



Davey Winder
Keeping small businesses safe since 1997 – **p118**



Steve Cassidy
The wider vision on cloud and infrastructure – **p120**

customers, both domestic and business, to invest in this really fascinating solution, then it has to stand by it through thick and thin. So the jury is out on this idea. Continuum could prove to be the technology that really is a “game-changer” in the mobile/portable space, and catapult Windows 10 Mobile from irrelevance to something definitely worth looking at, but it requires commitment. Will Microsoft step up to the plate?

HoloLens

Next up was the HoloLens, and what a strong and provocative demonstration! Clearly this is going to be a hit in the home, with aliens crashing through the lounge wall and hopefully (for the youngsters) being able to overlay a monster suit on Mum. But yet again, Microsoft was playing fast and loose with nitty-gritty facts about the real angle of view, and the display performance on real workloads. But a developer kit is coming, at the rather gasp-inducing price of \$3,000 (around £1,950). Unfortunately, this price will deter everyone except the truly determined.

Let’s move on to Surface 4. Yes, it’s based on the new Intel chipsets, which was entirely predictable. It now has some good storage options, too, and has received a proper makeover in all the important areas. It will doubtless sell well, although the price is a little on the rich side: at £1,799 for the 512GB, Core i7 and 16GB of RAM model, it’s undoubtedly a lot for a tablet. Add another £110 for the keyboard and you’re looking at just over £1,900. I note with interest how Microsoft manages to charge £350 for 256GB of storage, whereas Apple charges £240 for the same amount, and that Microsoft wants £35 for a VGA adapter and £35 for an Ethernet adapter, whereas Apple wants £25 for each. But it’s still fashionable to knock Apple for its accessory pricing!

The surprise of the show was

the unveiling of Surface Book, a new convertible laptop design that features a real keyboard, with extra batteries in that part too, along with the GPU. The screen component is effectively a modified Surface 4.



This could well become the definitive high-end Windows laptop device, because it offers everything – laptop operation that’s possible for those of us with normal-length legs (the Surface 3 and 4 require very long legs if you want to use their keyboard too), and you can twist and even detach the screen component. The hinge looks fascinating, too, and there’s a lot here to look forward to. I’m not so sure about the battery life, which is quoted at around three hours when operating in undocked tablet mode. And what happens to the fingerprint reader when the screen is detached? I’ll have to find out.

The price isn’t cheap, starting at \$1,499 for the basic model and rising to \$2,699 for the 512GB/Core i7/16GB RAM version, and there’s no news at all yet about availability outside of the USA and Canada (I guess squeezing a “£” key onto its keyboard is proving to be a tough problem). I’m very much looking forward to this device, because there’s been something of a dearth of decent high-quality Windows laptops recently. Samsung used to do a good job, but pulled out from the European market completely for its domestic products. Maybe Microsoft can make a laptop that I really want to use – only time will tell.

So why launch such high-end products? Well, it’s where the money

ABOVE The HoloLens looks exciting, but it’s not yet a meaningful product for market

“I have almost nothing but contempt for the Ballmer era”

is. Just ask Apple! And yet the cold reality is that Microsoft had no choice but to launch these various devices. The smartphone Continuum feature could be very clever as I’ve already said, but without it what differentiation would these Nokia phones have in the marketplace? Why would I want one compared to a Samsung S6 or Apple iPhone 6s?

Similarly in the laptop marketplace, would I really want one of these quite dreadful low-end devices whose price has been pared to the bone and which appear to be made out of recycled fast-food containers? If Microsoft isn’t prepared to back its own Windows-everywhere strategy, then it hasn’t got a hope in hell of getting anyone else to do it for them. Not given the almost post-apocalyptic state of the third-party Windows hardware marketplace, and the even worse state of the Windows Phone/Mobile market. Maybe they can really pull this off.

What is clear to me is that this could never, ever have happened under Steve Ballmer. The arrival of Microsoft applications and technologies on platforms other than Windows shows that the new Microsoft management finally “gets it”, and is doing its absolute best to right the wrongs of the previous decade and a half. As I’ve said before, as an outsider looking in at Microsoft for the past 30 years, I have almost nothing but contempt for the Ballmer era. Bill Gates left because he couldn’t cope with the company growing to be such a size that he was unable to spend time with each group, and to understand what they were doing. So he backed away, defeated, and handed the reins to his most trusted sidekick Ballmer. That Ballmer was not suited for the job wasn’t part of the recruitment process – I’m sure he did his best, but by then Microsoft had become



LEFT The Surface Book could become the definitive high-end Windows laptop

an almost uncontrollable monster. With the departure of Ballmer, it's crystal clear that Nadella is prepared to turn the rudder on the ship in radical directions. Based on what he's achieved so far, there can be no doubt that he means business.

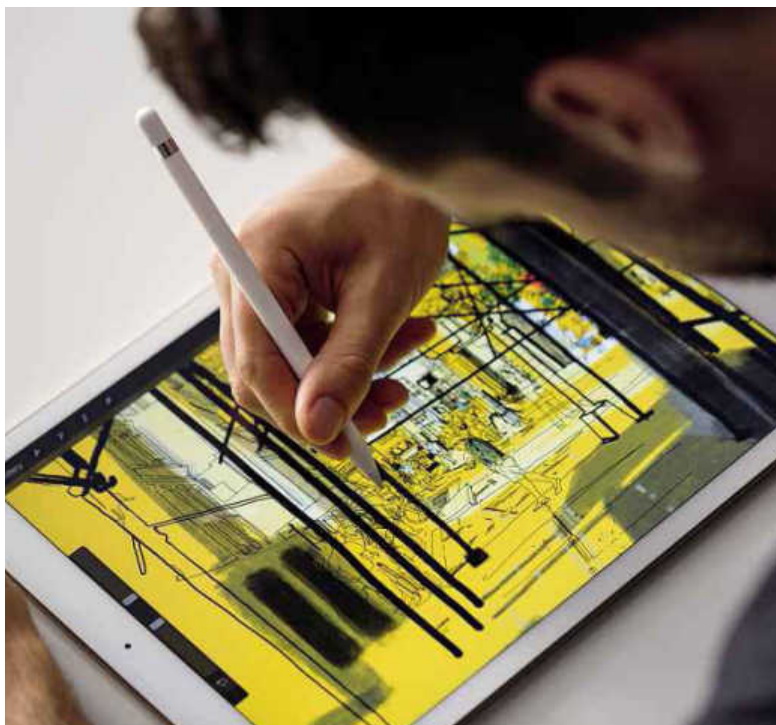
I can't wait to try the new phone in its Continuum arrangement, and that's something I didn't think I would ever be writing again. Surface 4 is interesting, but I myself bought 1, 2, 3 and the RT version too.

Surface Book is intriguing, if only as proof that Microsoft is backing down from its proposition that Surface itself was all you actually needed. As for HoloLens, let me know when there's something real and meaningful for the market to engage with and enjoy. As they say, we live in interesting times.

Apple news

Of course, this orgy at the Microsoft Love-In has somewhat overshadowed the news from Apple. Watch 2 has shipped, along with iOS 9 and El Capitan OS X. We're waiting for new hardware based on the new Intel chips, but these will arrive soon. Intel has announced that Thunderbolt 3 will be based on the USB Type-C specification, which is interesting news too.

I've upgraded my 6 Plus phone to the 6s Plus version, with the same 128GB of storage, and to be honest I'm still struck by the improvements. I know it looks and operates almost the same, but it's the small details that matter. The juiced-up fingerprint reader is so fast you simply don't register that it's reading your finger. The "3D Touch" on the screen is beguiling, again because it just works – there's no real conscious shift required of you to make good



ABOVE The iPad Pro will have interesting significance in the larger-screened tablet market

use of it – it just happens. The performance of apps is much snappier, and the battery life is still very strong, despite a smaller battery being fitted to the device.

Apple has also announced the iPad Pro, which will have interesting significance for the high-end, large-screen iOS marketplace. Of course, comparisons are already being made between the iPad Pro and the Surface 4/Surface Book. The Microsoft fanboys are claiming that the iPad Pro won't have the breadth of apps that Microsoft's platform can bring. At

BELOW Drobo's 5D device has left me with 23TB of storage for editing raw 4K video



the same time, the iOS fanboys are claiming that, while this may be true, the breadth of apps on the Microsoft platform unfortunately includes a catastrophic range of malware too.

And on the subject of malware, Apple has had its first significant malware problem with the iOS store, when hackers in China managed to pollute the development tools stack and succeed in getting malware compiled into the apps. It was a truly ingenious route, and one that seemingly was mostly confined to China. But some people are suggesting that it shows all the hallmarks of a bigger, possibly government-led intelligence operation. There is no doubt that Apple is doing battle with American intelligence divisions over access to encrypted data held both at Apple and on Apple devices. Perhaps it's just too much of a James Bond thing to suggest that the CIA had a hand in the development of this hack, although I suspect that we'll never know.

Drobo storage

I decided that I needed another bunch of storage on my Mac Pro desktop workstation. Its built-in solid-state storage is ridiculously fast, but there's only 1TB of it. That sounds like a lot – right up until the point at which you start editing raw 4K video. In the past I've bought a number of the Promise R6 RAID devices connected via Thunderbolt, and they've given excellent service. But the temptation of the new 6TB hard disks was too much, and so I decided to look elsewhere for this particular upgrade. Drobo was a name that has been on my radar for a long time, but I confess I've never actually owned any of its kit. In the early years, there were some scare stories about their devices lunching the data, but this never happened to anyone I knew (and a degree of caution about stories gleaned from the Intertubes is always wise).

In the end my eyes alighted upon Drobo's 5D device that can take five 3.5in hard disks. The 5D can connect directly via either USB 3 or Thunderbolt, and so I connected it via the fast Thunderbolt bus to the Mac Pro circular tower. For storage I bought five of the 6TB WD Purple drives and slid them in. Configuration took a few moments, including a firmware upgrade, and formatting the drives into two partitions took a few moments more. Afterwards I was left with some 23TB of storage. Performance is strong and certainly

not to be sniffed at: it might not match the raw throughput of the Promise arrays or the internet Mac Pro storage, but it's not slow. So far my impressions are positive, and I look forward to using it in anger over the next month or two.

And what was the reason for purchasing this much additional storage, which takes us to well over 100TB of online storage, along with another 50TB of LTO-6 tape library? I have a whole bunch of VMs to deal with on my desktop over the next few weeks, probably around 40 or so, each around 40GB in size. If it passes muster, then I might consider Drobo's B1200i iSCSI device for the network. This was well received in its *PC Pro* review and it certainly looks interesting, if a little bit leggy in terms of age. Maybe I should ask whether something newer is just around the corner.

I could be tempted by the 1U rack-mount LaCie Thunderbolt arrays, but LaCie and I have had disagreements over the expected life of power supplies. I like the design, and usually most of the implementation, but I've been let down a couple of times by weakened and failing power supplies. Yes, of course such a jaundiced view is wholly unfair when applied to an entirely different and brand-new product from its 2015 range, but memories linger.

Safe Harbour?

Excuse me while I laugh. The highest court in Europe has just decided that the Safe Harbour process for data transfers between Europe and the USA is a complete sham and isn't worth the paper it's written on. Allow me a moment of gloating for bringing this to your attention in this column most of a decade ago, when I started digging into the whole emerging USA-centric cloud-storage marketplace.

Microsoft has put out a statement saying that it thinks everything is okay because it has data centres in Europe and could therefore ensure that data doesn't leave the EU and get taken to the USA under pressure from an American court, or the Department of Justice. Excuse me if I just hold fire on that until the whole mess about USA jurisdiction over foreign data held on foreign soil is clarified once and for all. The current debacle over Safe Harbour, however, is long overdue and will doubtless help to move the discussion forward.

jon@jonhoneyball.com

PAUL OCKENDEN

"Evohome is spoiling me, making me seek a level of comfort I hadn't thought of before"

The sophisticated central-heating and hot-water system can be fine-tuned using IFTTT recipes

It's four months since I wrote about getting the Honeywell Evohome system installed at Chez Ockenden (see issue 251, p113). For those who missed it, Evohome is a sophisticated central-heating and hot-water control system that operates using wireless sensors and actuators, and which can be controlled from a smartphone. It's hard to think of anything more suited to this column!

The two main benefits that Evohome brings are economy (the manufacturer claims savings of around 40% on your fuel bills), and comfort – the result of finer control over the temperature of your home, and particularly having different temperatures in various "zones" at certain times of the day or week. Unfortunately, I don't have enough data yet to report how much it has reduced my energy bills, and that's exacerbated by the intervening months being the warm summery ones, when the heating hasn't come on. However, I did discover something interesting during the spring and autumn months.

In the past, I've laughed at people who say "it'll soon be time to turn the heating on" once the days start to get colder. That's because, for me, there never was any switching the heating either on or off – the thermostat on the wall did that. When the weather



Paul owns an agency that helps businesses exploit the web, from sales to marketing and everything in between

[@PaulOckenden](#)

got warmer, the heating would stay off and, as the days grew colder, it would turn back on again. All by itself, with no manual intervention required. However, since having Evohome installed – which provides far tighter control over temperatures – I've found that, although it's great that the heating comes on by itself, during the spring and autumn weeks I don't want the house as hot as I would during winter months. At that time of year, sunny days mean cloudless skies, which in turn mean rather cold nights. When there's a bit of a chill in the early morning and evening, it's nice to warm things up a bit. However, I've discovered that heating the house to our usual winter temperature of 20–23°C feels too hot at these times of the year.

I think it's partly psychological: after a warm day, a cooler evening is welcome, but you don't want them too cold. A bit of heating is nice, but you only want the system to take the edge off without coming on full-blast. Evohome is spoiling me, encouraging me to seek a level of comfort I hadn't thought of before.

The three degrees

The immediate solution lay in Evohome's special "Eco" mode, which temporarily overrides the set temperature for all zones, and

BELOW I continue to be impressed by the Honeywell Evohome system's controls



reduces them by three degrees. That's perfect for the sunnier days during these transitional weeks, and makes the living space much more comfortable. However, selecting Eco mode has to be done manually, so I've joined the ranks of the "manual intervention" brigade, the very same people that I've previously laughed at. And that just won't do. So there's a further solution to hand in the shape of IFTTT, a web- and app-based "recipe" system.

Recipes? Has Paul lost the plot and started writing about cooking? The meaning of "recipe" in IFTTT usage is a list of triggers and commands, which will probably make more sense once you know that IFTTT stands for "if this then that". Before I explain how this utility helped solve my Evohome problem, let me give you a quick explanation of exactly what IFTTT is, what it does, and how it does it (*for hands-on advice about using IFTTT see issue 253, p54*).

I need to start by telling you how to pronounce it. I've heard people call it "eye eff triple tee", "eye eff tee cubed" or even the full-fat "eye eff tee tee tee", but its vendor's preferred pronunciation is simply "ift", like rift without the "r". (As a personal aside, apart from the cool things that IFTTT can do, one of the things I love most about it is that its own explanation page is hosted at the hilarious URL ifttt.com/wtf). IFTTT was first released four years ago and has grown in both stature and popularity since.

The best way I've seen it described is as a "middle layer that sits between the physical world and the internet". It works by enabling you to write recipes, of which there are two different types: IF and DO. The IF recipes are what IFTTT was originally created for. An example could be: "If I take a photo on my phone, upload it to Dropbox". I realise that the Dropbox app is supposed to do that for you, but it doesn't always work and the IFTTT recipe seems far more reliable. Other example recipes could be: "email me if it's going to be sunny tomorrow", "flash my office lights if my stock prices fall" or "post to a Slack channel when I arrive in the office". That list should tell you that the range of possibilities is very diverse.

DO recipes are similar, except they're triggered from a GUI button,

rather than by something happening in the background. If you've invested in home-automation, that could be something like pressing an icon on the homepage of your phone to "turn the lights down" or "open the garage door". In a work scenario, it could be tracking your work hours or creating a calendar event. DO recipes can be useful, but I find it's IF recipes that I use most. IFTTT's real power comes not from recipes – important though they are – but from its "channels", the numerous third-party systems, data feeds, websites, cloud services and apps that IFTTT can talk to. Some of these are used as inputs to trigger a recipe ("if the International Space Station flies overhead") and others as outputs ("send an alert to my Android Wear smartwatch"). There are hundreds of these channels, including home-automation, fitness devices, car apps, music, productivity apps and social media.

This is where Evohome enters the picture, as Honeywell has created an IFTTT channel for it. There are no triggers from Evohome, which is a shame because it means I can't do something such as "if the loft is too warm, lower the blinds on the Velux windows", but I can turn my hot water on or off, override the temperature in a zone, and enable one of Evohome's "Quick Actions" such as the "drop every zone by three degrees" Eco mode. The simplest way to do that was by combining Honeywell's channel

with the Weather Channel's "Current Conditions" trigger, which returns one of the four values, "Rain", "Snow", "Cloudy" or "Clear". I needed three recipes (ignoring Snow, which is unlikely during the summer to autumn transition). So if the current condition changes to Clear (a sunny day) then turn on Eco mode, but when it becomes either Cloudy or Rain then turn Eco mode off. It means that, on a warm autumn day, I get just a small amount of extra heating, whereas on cold and wet days the heating comes fully on.

I asked around to gather some further real-world examples of people using IFTTT with Evohome. A home-automation guru

"IFTTT may be great, but it's not perfect: its single-action mechanism is limiting"

BELOW IFTTT enables you to extend the capabilities of your system, and includes published recipes

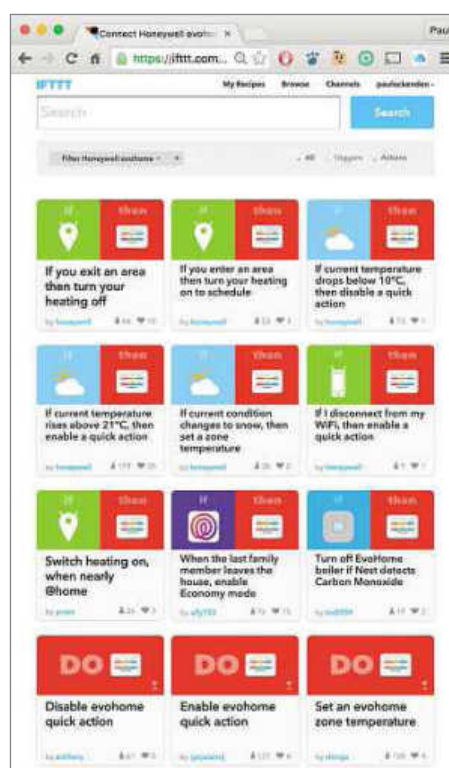
called Mavis told me: "I use it mainly when my son is on the day shift, as he starts much earlier than me. The recipe picks up the entry "Day Shift" in my Google Calendar at the time I want the heating to come on. I have a separate recipe for each zone (kitchen and bathroom), and I have it set so that the heating comes on for an hour. During the spring and autumn, I also have two geofencing recipes that are set on my phone so that, when I leave for work, the heating goes into Eco mode and then switches back on when I come home. I can't use it during the week in the winter, though, as hubby would notice the heating had been turned down."

IFTTT may be great, but it's not perfect: its single-trigger/single-action mechanism can be limiting, as in Mavis' example. For a start, she needed to create separate recipes for each zone for her shiftwork actions, and her geofencing recipes only work for one user. In my own example, the recipe would be so much neater if I could say: "If it's late September OR early October AND the temperature today has been warm AND it's going to be clear skies tonight then..." , but the system doesn't support multiple triggers. At least it doesn't by default, but there are some "hacky" ways around this, such as the "Maker" channel. This is intended to support your own web projects, but you can also use it to accept triggers from several different IFTTT recipes and then trigger another one, based on a logical combination of all of those inputs.

It would be nice if IFTTT supported more complex recipes with multiple triggers, Boolean logic, outputs and time constraints, but IFTTT's simplicity is what's made it so successful. For now, it does what I need, and it was a good decision by Honeywell to interface Evohome to IFTTT rather than develop its own logic engine.

Taking the temperature

It might be worth looking at some of the data that the system generates. There is wireless data flying all around the house between the controllers,



sensors and actuators. These messages are at 868.3MHz and are encoded at 38,400 baud. A few people have tried to brute-force decode these messages, using kit such as RFM12B receivers or JeeLink dongles, but it's easier to purchase a Honeywell HGI80 gateway (for interfacing Evohome with home-automation systems such as Somfy's TaHomA), and various third parties have created software that can interface to Evohome via the HGI80. One of the best of these programs is the open-source Domoticz, which will run on everything from PCs and laptops to Raspberry Pi and NAS boxes. It's quite hard to find an HGI80 here, however, since they aren't officially sold or supported in the UK, but if you look further afield you can find them on sale in various countries in Europe.

If all you want to do is see, log or chart temperatures in the rooms in your house, there's an easier option that doesn't require additional hardware. This relies on the fact that the Evohome smartphone app (called Total Connect Comfort) doesn't speak to your system directly, but rather does everything via a cloud-based infrastructure in the USA. Your heating system uploads a list of the current room temperatures to the cloud, and the app reads these back and then returns a list of control commands. If all you want is a list of temperatures, you can make use of this cloud system.

There's an API that Honeywell has made available to third-party partners, allowing them to interface to Evohome, but details of it have also leaked out to the "hobbyist" community. Many IT companies would close down such a leak, but a senior person at Honeywell has told me that they really value and encourage the "tinkerers" as they provide useful product feedback. People who access Honeywell's API on the sly are tolerated as long as they don't abuse the system – for example, by posting too many requests very quickly, which may get them blocked.



Let's look at how this might work. I'm not going to provide a complete program listing here, but I'll give you some pointers using Python. The first thing you need to do is make a JSON post to Honeywell's cloud server:

```
url = 'https://rs.alarmnet.com/
TotalConnectComfort/WebAPI/api/Session'

postdata = {'Username':USERNAME,
'Password':PASSWORD,'ApplicationId':'91db1612-
73fd-4500-91b2-e63b069b185c'}

headers = {'content-type':'application/json'}

response = requests.post(url,data=json.dumps(post
data),headers=headers)

userinfo = json.loads(response.content)
```

The username and password are the ones you use to log in to Evohome from your smartphone app. That ApplicationId is something you'll find if you fire up Wireshark and sniff the data between the app and cloud servers. It's currently the same for all users, but Honeywell could start using that to close the system to unauthorised users. For now, your scripts will be fine using this ID. Note that the URL is "alarmnet", which is Honeywell's online service for intruder detection and other security applications: it seems that the Evohome system piggybacks on that infrastructure.

After posting the username, password and ID, the cloud servers return a JSON response, containing two things you'll need to post further commands, a user ID and a session ID:

```
userid = userinfo['userInfo']['userID']

sessionId = userinfo['sessionId']
```

Once you have those, you can start to issue further requests, for example:



ABOVE The HGI80 gateway allows software to interact with your Evohome system

"You should poll the data every ten minutes as temperatures don't change very quickly"

```
url = 'https://rs.alarmnet.com/
TotalConnectComfort/WebAPI/api/
locations?userd=%s&allData=True'%userid
```

```
headers['sessionId'] = sessionId
```

```
response = requests.get(url,data=json.
dumps(postdata),headers=headers)
```

```
fullData = json.loads(response.content)[0]
```

More JSON data, this time containing information about the various zones. To extract it you'd use something like:

```
for device in fullData['devices']: print
device['thermostatModelType'],
device['deviceID'],device['name'],
device['thermostat']['indoorTemperature']
```

You should see temperature data returned in the following format:

DOMESTIC_HOT_WATER 111111 53.0

EMEA_ZONE 111112 Bathroom 20.5

EMEA_ZONE 111113 Lounge 21.0

EMEA_ZONE 111114 Hallway 19.0

EMEA_ZONE 111115 Bedroom 19.5

EMEA_ZONE 111116 Kitchen 20.0

EMEA_ZONE 111117 Loo 19.0.

All those 111111s replace numbers that will be unique to your installation. It's then easy to log them in a database to monitor how your temperatures vary over time. You can even use one of the online data-visualisation tools such as Dygraphs, D3.js, Google Charts, Datawrapper or Plotly. I'd suggest you poll this data every ten minutes or longer: you certainly don't need anything more frequent as room temperatures don't change quickly, and you might get banned from the servers – endangering the viability of the tinkerer community.

It's great fun extending Evohome like this, and these code fragments should give you some inspiration. There are also examples of other people's work out there, on places such as GitHub, but it's better if you can roll your own code to understand what's going on. I'm still impressed by Evohome. That said, the main benefit for me is still comfort rather than saving money, but perhaps I'll change my mind once I start to see reduced bills start to appear during the winter.

@PaulOckenden

TOMARAH

“Adobe Stock is turning the dream of instant access to the ideal image into a reality”

Adobe hopes to revolutionise the royalty-free market with a new initiative that uses Fotolia's impressive library and userbase

Every creative project, from a simple one-off poster to a full-blown multimedia extravaganza, needs graphics. While good images can make your project, bad ones will ruin it, so it's worth putting in the effort to make sure you're using the best possible assets.

Thirty years ago, I commissioned photographers for projects that had the necessary budget and scoured through printed catalogues of black-and-white royalty-free images for projects that didn't. Twenty years ago, I spent a fortune on a new-fangled CD-ROM containing hundreds of clip-art images of the sort that would now embarrass your granny. At the time, I was absolutely delighted with it.

Eventually, the web arrived and transformed the field. Online delivery made it possible for image suppliers to make bitmap photos and vector illustrations instantly available to the entire global audience of content producers. The royalty-free stock graphics industry was born and quickly became a big business.

Now Adobe hopes to transform the royalty-free market with its new Adobe Stock initiative – whether you happen to use Adobe apps or not.

To take advantage of Adobe Stock all you need to do is visit stock.adobe.com/uk. You'll find a typical stock image site, but with a modern and attractive front-end – important for usability. However, what really matters is the quality of images and the number on offer. After all, if a search only returns one or two usable images, the chance that these will suit your project will be vanishingly small. What is immediately striking about Adobe Stock is that, even though it only officially launched in June, the site already offers access to more than 40 million images and,



Tom set up his Edinburgh-based design company in 1987, and also provides training and consultancy

for the price, the quality of the imagery is extremely high.

The reason is simple. Adobe Stock is a new front-end to the well-known Fotolia site that Adobe purchased for \$800 million at the beginning of the year. Fotolia has been operating since 2005 and, over the past ten years, its high-end crowdsourcing approach, built on encouraging as many stock contributors as possible, has paid off both in terms of the numbers of images in its library and its registered userbase, which is over three million. Adobe Stock is building on top of one of the best stock photography collections around – and most open and successful P2P infrastructure.

Finding the right image

So how does Adobe Stock stack up in practice? It's certainly very simple. In the middle of the graphical home page is a large search box. Simply type in your search term, select whether you're interested in photos, drawn illustrations or vector images, and hit OK. All of the images are well tagged and the collection is so large that you're almost guaranteed relevant hits. You will certainly want to use multiple terms to make your search more specific. For example, you should try to search for “Indian

elephant” or “elephant sunset” or “elephant water”, rather than just “elephant”.

The resulting thumbnails are large enough to give a good idea of each image and, for a closer look, clicking on one will open up a bigger preview along with information about image resolution and format. In many competing collections, this involves jumping to a new page, but with Adobe Stock this is all handled in situ via Ajax, which makes for a much smoother experience. On the other hand, the lack of infinite scrolling is disappointing.

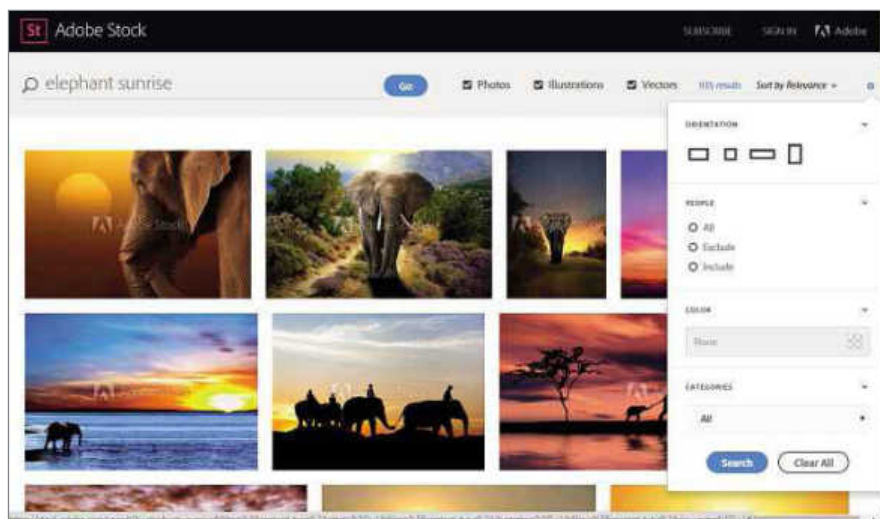
Using the Settings dropdown panel to narrow in on the right image allows you set ongoing criteria for your current search. For instance, you can choose to limit results to images that are landscape, portrait or square, depending on the slot you want to fill. I also love the ability to set a colour so you can find imagery to complement your project's colour palette. You can also choose to limit your search to a particular category. Select the “Culture and Religion” option and you can explore elephant gods and statues rather than shots of the African savannah.

When a particular image catches your eye, try searching for similar items by simply clicking the large magnifying glass button that appears over each image as you mouse over it. This is by far the best way to search for images around a certain theme, without having to keep entering new terms. Furthermore, it's an excellent way of finding images with a similar look and feel, often from the same contributor, which can make it look as if you commissioned your shots from a photographer.

Once you've identified a potential image, you can either hit the shopping

“Adobe Stock's website already offers access to over 40 million images and the quality is high”

RIGHT The Adobe Stock site provides access to a vast collection of high-quality images



cart button to buy it or the download button to save a watermarked preview image to your computer. If you've signed up to Adobe Stock, you can save images to your custom libraries. This is very useful for quickly building up multiple potential choices. By then visiting your library you can quickly compare your options before choosing the best, rather like designers used to do on a lightbox.

A cunning cloud plan

Adobe has made a pretty good job of the Adobe Stock website and I recommend you take a look at it. However, the company's ambitions don't stop there: Adobe Stock is an integral part of its Creative Cloud strategy. Indeed, integrating Stock directly into the Creative Cloud applications was the central focus of the recent CC 2015 release. This is immediately apparent from the central Creative Cloud launch app, which now provides quick access to the Stock search bar from a separate tab.

More importantly, Adobe Stock has been directly integrated into each of the main CC 2015 print and video applications – Photoshop, InDesign, Illustrator, Premiere Pro and After Effects (royalty-free video is clearly in the pipeline). In each case, the means of access is the same. You simply open the shared Libraries panel and click on the Adobe Stock icon in the bottom-left corner. At that point, your browser opens and you're taken to the Adobe Stock website. Hmm, so not completely integrated after all.

Don't let this put you off. No doubt direct search within the app will come in due course, but Adobe Stock is already far more integrated than the semi-detached handling suggests. This becomes apparent as soon as you save a preview to a Library. Within a few seconds, the preview thumbnail will automatically appear in your app's Library panel ready to be dragged onto your design. In other words, you don't have to go through the hassle of saving your files and then locating and loading them. Even better, thanks to cloud-based Library sharing, your preview images are instantly available across all your Stock-enabled Creative Cloud 2015 apps, be they desktop or mobile.



That's just the start. You can quickly take advantage of your preview images, to explore which work best in your layout. You can also go further, applying adjustment layers or filters to your previews. When the project has been given final approval you can simply right-click on each image and select License This Image: the high-resolution, watermark-free original will be downloaded and your layout updated accordingly, including any changes that you have made to the previews.

How much?

So how much does Adobe Stock cost? For one-off users of the website, Adobe charges a flat fee of £6 exc VAT per image. Of course, Adobe really wants you to use the service regularly, so it offers a number of lower-cost subscriptions, starting at £30 a month for ten images, with additional images

costing £3 each. If you're willing to commit to more images per month – these now automatically roll over so you don't lose any unused allocation – the price per image drops accordingly. Adobe's ultimate goal is for you to subscribe to Adobe Stock and Creative Cloud. As an added incentive to Creative Cloud members, you

ABOVE Library-based handling of Adobe Stock images has been integrated into all of the main CC 2015 apps

not only get all the benefits of in-app handling, but also an additional 33% discount on the regular non-Creative Cloud pricing.

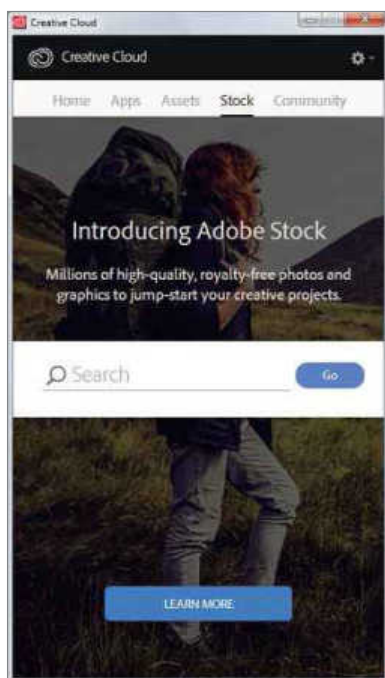
Compared to free-to-use public domain images, this royalty-free licensing approach still isn't exactly cheap. However, Adobe Stock is in a different league both in terms of convenience and quality and, in the context of a professional design project, the Stock images will be more than worth the price.

Moreover, one of the attractions of Adobe Stock is that it could actually make you money. After all, Adobe says that 85% of those designers who use stock imagery also use its programs. That's 85% of a \$3 billion industry. If you're a professional photographer or illustrator, then that's a large and rapidly expanding market you could be tapping into. If you're interested in selling your images to Creative Cloud members through Adobe Stock you currently have to sign up via the old **fotolia.com** site, but no doubt Adobe will be working on tighter integration here too.

This is what makes Adobe Stock so exciting. By leveraging its CC users as both content producers and content consumers, Adobe helps everyone. Moreover, by making it as easy as possible to both add new images to the shared Stock pool and to take advantage of them, Adobe is helping unlock the full potential of its Creative Cloud userbase.

Thirty years ago when I started out, trying to find the right image to put a spark of life into a design project or to give it the perfect finishing touch was a real time-consuming chore. Adobe Stock is turning the dream of instant access to the ideal image into reality, and helping it to become an integral part of the whole creative process.

tomarah@designer-info.com



LEFT Adobe is shaking up the royalty-free graphics market with Adobe Stock

DAVEY WINDER

“GCHQ’s advice is to make passwords less complex: Mandy Rice-Davies applies!”

The reasoning seems to be that forcing changes on users will result in them choosing passwords that are only minor variations of old ones. Say what?

Two final nails in TrueCrypt’s coffin

Six months ago, I was guilty of sitting on the fence over the question “should I still use be using TrueCrypt?” There were several reasons you might not have wanted to use encryption software last released in 2012 and dropped by its own developers in 2014, who warned “TrueCrypt is not secure” and abandoned any further support. TrueCrypt had been the encryption choice for much of the open-source community for a decade, and an independent security audit (pcpro.link/255truecrypt) in 2015 found “no evidence of any design flaws severe enough to make it inherently insecure”.

However, I stated on these pages that business users would be on dodgy ground if they used a non-supported security product declared insecure by its own developer, if a breach occurred. For consumers, it’s been harder to abandon what they knew, but my recommendation was – for those unable or unwilling to move to a BitLocker-compliant version of Windows – to at least consider moving to a TrueCrypt code fork called VeraCrypt that offers the advantages of its parent, but with ongoing support and fixes for future vulnerabilities. Which was handy, because that’s exactly what has just happened.

Researchers from the Google Project Zero team have found two privilege elevation vulnerabilities



Davey is an award-winning journalist and consultant specialising in privacy and security issues
[@happygeek](#)

“If the two vulnerabilities don’t scare you off TrueCrypt forever, then I despair”

BELOW James Forshaw from Google’s Project Zero hammers nails into the TrueCrypt coffin via Twitter

that appear to have escaped the attention of the 2015 auditors, both rated as critical and already patched by the VeraCrypt developer. These vulnerabilities will, of course, remain unfixed in TrueCrypt, so it’s only a matter of time before exploits emerge. Details of these vulnerabilities hadn’t been disclosed at the time of writing, but I know that one of them (“CVE-2015-7358 (critical): Local Elevation of Privilege on Windows by abusing drive letter handling”) involves a TrueCrypt driver improperly validating a drive-letter symbolic link for mounting drives. This could be easily exploited by an attacker to obtain full admin privileges. I understand the other vulnerability (“CVE-2015-7359: Local Elevation of Privilege on Windows caused by incorrect Impersonation Token Handling”) is about the way a TrueCrypt driver validates, or does not validate, the security context of a “calling” user, making it possible to dismount a volume or to reconfigure the software by pretending to be another user on a shared machine.

If these two vulnerabilities don’t scare you off TrueCrypt forever, then I despair, especially when VeraCrypt is doing such a fine job of keeping the original spirit of TrueCrypt alive in a more secure way.

MRDA to GCHQ password advice

Mandy Rice-Davies applies (MRDA) isn’t a phrase that gets much use these days, but it applies to the password-guidance document (pcpro.link/255password) released by CESG, the information security arm of GCHQ. Why would we not listen to advice on passwords from an organisation that describes itself as “the definitive voice on the technical aspects of information security in

government” and that works at “keeping sensitive and sometimes secret government information secure from hostile threat”? Maybe because GCHQ, in collaboration with the NSA, has been monitoring our private communication, as discovered courtesy of Mr Snowden back in 2013?

The implication of MRDA is “they would say that, wouldn’t they”. For example, GCHQ director general for cyber security, Ciaran Martin, says in his introduction: “Complex passwords do not usually frustrate attackers, yet they make daily life much harder for users. They create cost, cause delays, and may force users to adopt workarounds or non-secure alternatives that increase risk.” He insists that by “simplifying your organisation’s approach, you can reduce the workload on users, lessen the support burden on the IT department, and combat the false sense of security that unnecessarily complex passwords can encourage.” Really Mr Martin? In which case, my immediate response is “you go first, old chap!”

Mr Martin and GCHQ do have a get-out clause that states the advice isn’t intended to protect “high-value individuals using public services”, but rather is aimed at system owners responsible for determining password policy everywhere else – namely, “do as I say not as I do”. I’m not saying that all the advice is bad, as some of it is common sense, but I am saying the tone of “make your passwords less complex, please” worries me. I agree with them that default passwords should always be reconfigured, and that access to admin accounts should be controlled using privilege management tools and protected by multi-factor authentication. I agree that lockout mechanisms to protect against brute-force attacks are a good thing, as is the proper hashing of stored passwords. I have no problem with telling people not to share or re-use their passwords, and agree that most password-strength meters are pure snake oil.

However, I definitely do not agree with his insistence that “regular password changing harms rather than improves security, so avoid placing this burden on users”. Say what? His reasoning seems to be that forcing password changes on users (say, every 90 days) will result in them mostly choosing new passwords that are only minor variations of the old. Maybe it would if your password policy allows for that, but it shouldn’t. I couldn’t





find anything in the guidance that actually justifies the claim that regular changes “harm rather than improve” security. What the document does say is that logins should be monitored for “unusual use” and users should be notified about attempted logins. Okay, I’ll agree with that too, but it still doesn’t convince me that password changes are bad. The only argument I can find is that “stolen passwords are generally exploited immediately,” which isn’t actually as clear-cut as it may sound. What if they’re not exploited immediately, but sold on? What if they are merged with other stolen credential databases and get passed around the dark web? What about all those times when, if your password had been changed through company policy, it would have been useless to the bad guys when they came to try it? Having purchased a database of thousands, if not millions, of credentials, baddies are unlikely to try every potential variation of each dud, but will simply assume it’s out of date and move on to the next.

Sure, it’s a different situation if you’ve fallen foul of a targeted attack or a phishing scam, but that doesn’t mean the risk is the same across all scenarios: data breaches often go undetected for months or even years. If passwords are compromised and remain unchanged during that time, I fail to see how this can be positive. I appreciate that password resets can be a pain for both users and tech support, but that’s usually due to poor procedure and doesn’t have to be that way. Done properly, a password policy that requires regular changes can be simple and increase your security. Limiting exposure to undetected compromises – likely to be most of them, if we’re honest – is a good thing for the balance of risk. Likewise, suggesting that complex passwords are somehow less secure than simple ones is utter bunk. Properly constructed, randomised and complex passwords frustrate attackers. That’s a fact.

Reading further into the document, it seems the counter-argument is based on the ease with which automated, brute-force attacks can defeat simple passwords, coupled with the difficulty users have in remembering complex ones. The latter can be overcome by using encrypted password vaults and management systems where only a complex master password needs to be remembered, and the former objection doesn’t apply to long and

complex passwords. GCHQ advises using technical controls such as lockouts and common password blacklisting in preference to complex passwords. Seriously, words fail me. Maybe advising against short passwords, maximum character limitations and dictionary words would have been a better option. The best option is to ensure that you make things as difficult as possible for the bad guys to access systems and use multi-factor authentication. If they do gain access to the data, make sure it’s of little use to them by encrypting it.

SYNful Knock

Last month I warned about the dangers of home and small-business routers that retain their default admin login credentials, and referred to the situation as router madness. This month the insanity has reached somewhat hysterical proportions with the discovery of the SYNful Knock malware. Cisco remains one of the biggest names in router tech, so it’s hardly surprising that its products remain popular targets for the bad guys. So when the FireEye Mandiant incident response and security-assessment services outfit uncovered a “router implant”, a “backdoor vulnerability”, and “persistent malware” impacting Cisco routers, and spotted it in the wild in Ukraine,

ABOVE Simple passwords are better than complex ones, say the spooks

“If attackers do gain access to your data, make sure it’s of little use to them by encrypting it”

BELOW A SYNful Knock scanner is available from Cisco, unlike properly signed router firmware

India, the Philippines and Mexico, it’s clear this was a big deal.

Dubbed “SYNful Knock”, this malware actually involves a stealthy modification of the router’s firmware. Modification of ROMMON images on Cisco Internetwork Operating System (IOS) routers isn’t a bug, but an admin tool used by network managers. Malicious ROM images, such as SYNful Knock, can replace the Cisco IOS ROMMON (IOS bootstrap) if the attacker has either physical or administrative access to the device. There has, inevitably, been some debate about whether the NSA or another state-sponsored agency is behind these attacks, but that argument falls in the conspiracy theorist camp at the moment. Sure, the exploit could be used to harvest data for espionage purposes, but it’s just as likely to be used by cybercriminals as it is by spooks. The privileged position of these routers means that, once installed, the threat actors could just as easily use the malware to perform denial-of-service attacks or data breaches as they could to spy on traffic.

I’m more concerned that some of the reports have used the term “implant” as if SYNful Knock arrived already installed on routers out of the factory, which it didn’t. Let’s get this straight, SYNful Knock isn’t an implant, but malware – albeit quite clever and certainly with the potential to cause much mischief. That said, it does require compromised credentials or physical access to the router itself to get “implanted”. Once again, and this must be the third time I’ve mentioned this issue, unchanged default admin credentials are a likely route to entry. Every pun intended, even though it’s no joke.

This isn’t exactly a new attack vector, and we’ve seen cases of home routers being exploited by malicious firmware in the past. In this case, it seems that the bad guys have just scaled things up a bit by targeting more industrial-strength routers, giving them the ability to spy on data traffic flows and cause conspiracy theorists to immediately hatch the “state-sponsored”

```
# python ./synknockscan.py xxx.xxx.xxx.0/24
xxx.xxx.xxx.1: SYNKnock indicators found: ACK/SYN seq numbers set to static offset; Static set of TCP options found
xxx.xxx.xxx.65: SYNKnock indicators found: ACK/SYN seq numbers set to static offset; URG flag off but URG ptr=25202; Static set of TCP options found
synknockscan.py: WARNING: Apparent compromised routers detected. Please contact Cisco's PSIRT at 877 228-7302 or psirt@cisco.com for assistance.
#
```

Continued from previous page

argument. Once the malware is in place it, in effect, creates a persistent backdoor to the router. It isn't a vulnerability in the router's firmware – it's malware, and pretty impressive malware at that. The obfuscation methods it employs mean it manages to evade standard detection methods for a long time, and its ability to persist on routers even after a reboot doesn't help a bit. Masking the malware by overwriting legitimate, but little-used, IOS functions means that the ROM image size isn't changed and neither is the real-world functionality of the router.

Cisco's Product Security Incident Response Team (PSIRT) has worked with Mandiant to confirm that SYNful Knock is a credentials problem rather than a firmware vulnerability, which means it's not fixable by a patch. Instead, it's a matter of discovering and removing it, followed by shoring up your security posture to prevent reinfection (and other breaches that may already be under way if your access credentials were that easy to circumvent). Cisco Talos, the main team that contributes threat information to the Cisco Collective Security Intelligence ecosystem, has produced a Python script to scan for any routers on a network that may have been compromised by SYNful Knock. This can be downloaded for free from papro.link/255talos1, with full usage instructions in the Cisco blog entry at papro.link/255talos2. That's all well and good and – assuming that the particular "knock" being used by the malware at any given time is detected by the scanner – will enable you to discover whether you've been infected or not.

However, what it doesn't do is address the much bigger problem, which isn't even the stupidity of people who leave default admin credentials on their routers, but rather the question of "why isn't router firmware signed with decent-strength encryption?" It can't be that difficult, and surely wouldn't add much cost, to provide firmware with the ability to be checked for authenticity by the router's chipset and only be booted if it were clean?

davey@happygeek.com

STEVE CASSIDY

"North America has only 50 more IPv4 addresses left than there are Siberian tigers in the wild"

That pointless factoid is typical of the breathless tabloid reporting on the IPv4 shortage – but it can reach out to bite all of us

How will the world be introduced to IPv6? The answer, based on my recent experience, is "not with a bang but a whimper" (to quote from T S Eliot, for all you millennials). Every so often there's a news item that tells us how many IPv4 addresses the world has left, something like "did you know North America has only 50 more IPv4 addresses left than there are Siberian tigers in the wild?" This is just the sort of pointless factoid popular in modern "news making" – appearing to provide hard information without telling you anything about the practical outcome. In practice, shortages like this are resolvable. The methods being used aren't what this tabloid reportage might suggest: the problem is mostly encountered by ISPs, not end users, and they mostly find a way to reallocate addresses used in the early days of the net that were never reused, or else they move ever more of their own hardware over to other protocols (of which IPv6 is only one).

Only if you're operating at the highest level and with the largest collections of machinery do addresses become a challenge. And this is fatally attractive to the nuttier, more breathless and easily impressed type of reporters who drop names such as Microsoft, Google and eBay. Most people's networks aren't quite that big (although if you do have more than 49,000 fibres in your WAN, drop me a line – I want a tour).

Running out of IPv4 addresses can still reach out to bite us from time to time, though. I once spent a month or so without any thumbnail pictures on my eBay listings. My connection was both IPv6- and IPv4-capable, and it turned out that eBay was using a curiously divested, separate server farm to serve pictures, so the connection between said server and my browser strayed at some point into IPv6 territory. Changing the local config of my dual-protocol connection summoned these thumbnails back from oblivion, but only after I'd



Steve is a consultant who specialises in networks, cloud, HR and upsetting the corporate apple cart
[@stardotpro](https://twitter.com/stardotpro)

"We're all used to the idea that fiddling can be performed without doing any active harm to a running system"

wasted weeks trying out different PCs, browsers, cables, switches, DNS servers, before ultimately stooping to call the helpline...

"Yes, well, Steve", say those of you who put up with my rants, "that's just you. You got that dual-protocol line for testing and you were fiddling, and that's what happens to fiddlers isn't it?" This is an important point because IT is nothing if not a fiddler's paradise. People expect things to work, especially things that make at least minimal reference to some standard (that's what standards are for, after all). We're all used to the idea that fiddling can be performed without doing any active harm to a running system, and that fiddles by definition exist in layers – you can apply them, then peel them off again, like plasters, without earlier work being compromised. Regrettably, IPv6 doesn't work like that.

The key difference is that the protocol's architecture is designed to allow global visibility of devices. This was because in the early days of the internet, the large number of packets with their network-address translation (NAT) attributes set caused the core routers of the planet-wide network to max out their CPUs – fans whirled, stuff got hot, failures followed. This early lesson about specifying adequate hardware was learned painfully by many folk who then went on to contribute to the IPv6 design. Meanwhile, more than a decade goes by in which we've come to accept NAT as a useful tool, the routers that must pass the packets it generates have acquired many orders of magnitude more processing power, and concerns over traffic have shifted away from legitimate NAT users over to illegitimate botnet armies, trojans, and babbling advert trackers.

This brings me neatly to my next source of IPv6 fiddle-failures, the "6-to-4 tunnel". Its name is pretty self-descriptive: a purely software structure that looks like another network card in your machine with



only an IPv6 address. Any traffic directed into it tunnels out, after being wrapped up in an IPv4 transport mechanism. In theory, this should provide a transparent IPv6 network layered over a non-transparent IPv4 network.

That may sound like an esoteric peculiarity, but consider the situation I saw recently where a cautious hosting company technical director had set up his DMZ so that his servers were all buried like little bee larvae deep within the honeycomb, communicating only with the outside world and not with each other. After his departure, the next man through the door decided to go for a 6-to-4 tunnel in preference to tangling with a several-thousand-user firewall. For a while, everything seemed tickety-boo. You know what comes next: after a high-volume Patch Tuesday, this hosting firm woke up to find this comb-full of bee larvae were no longer chattering away merrily. Something had changed in the way Windows Server 2008 handled a lot of the protocols they were using and, most importantly, the “order of service by connection” had changed.

That might sound like some Freemasonic ritual, and there are indeed similarities: both are arcane, partly secret, and their names give no indication of their importance. The “order of service by connection” is what Windows imposes when it sees more than one active network card in your system, and/or more than one active IP address. It used to be that Windows would listen on all the addresses and cards you offered it, and then choose one to send out for all traffic types and uses. The rule was generally that the one with the lowest-numbered IP address would be the one to do the sending. This was recently overturned, however – you can’t make comparisons like “lowest” when considering IPv6 versus IPv4. Yes, FEC:0FFF:DEAD:BEEF really is a legitimate IPv6 address, and is that higher or lower than 10.0.0.1?

The rules have changed, and the quickest way to find that out is by applying a security patch that suddenly prioritises IPv6 over the IPv4 one you’ve been using, testing, trusting and configuring everything to for the past decade and a half. Especially when the chap who turned on all that 6-to-4 config at my clients’

site didn’t perform a test to see whether this was actually the live transport, even after he’d done it. So far as I could tell – in the middle of a cold-sweat panic at 1.45am – the key problem was that the firewall that managed their server farm knew enough about IPv6 tunnelling to regard it as a gaping security hole, and therefore to forbid v4 packets with v6 internal payloads to pass around the LAN. I had to go hunting, extremely quickly, for some tool to unravel and simplify all the 6-to-4 configurations, before working out precisely what these security updates had done to their multi-IP server configurations.

The snag was that, although their 6-to-4 installation behaved like a virtual Ethernet card, it didn’t appear as one in the Network And Sharing Center. It’s not an add-on in the list of per-connection properties either – in fact it’s a slippery, invisible beast. If you need to go and play with it, I’d suggest starting at pcpro.link/255sc1. Note that this is all about PowerShell cmdlets, and should therefore be treated with respect. Don’t just start typing stuff into your only server or laptop. In fact, only go there if you’re sure you haven’t been caught in a fiddler’s trap, whether that’s by your own fiddling or someone at your ISP saying “I’m sure this won’t cause a problem...” I’d prefer you to go first to Technote 929852 (pcpro.link/255sc2). Have a good long read of this page.

As an aside, this Technote sadly follows the modern trend of a headline that fails to convey what’s

“I can’t imagine why anyone would want to blithely switch network protocols on and off”

BELOW Microsoft is finally giving some straightforward advice on IPv6

found further down. As is almost inevitable today, this applies to many more versions of Windows than it suggests, containing no fewer than ten download links to MSI installers. It executes a fifty-ton, clod-throwing, tractor-pull through the fragile and diverse field of advice that Microsoft has ever put out about using IPv6 in Windows. Reading through all the ways Microsoft employs to let information out about its approach to networking is a task in itself, demanding time and patience – and possibly one of those big yellow, ruled legal pads to map out all the different approaches to the topic, ways of saying the same thing, and dates at which they were said. That’s not what I need when I’m stuck in a technical knot: I just want a focused summary of the current position.

In effect, Technote 929852 is a result of Microsoft discovering that its pious wishes don’t cut it in the real world – namely, that everyone should be able to run IPv6 just the way folk do in the Puget Sound Campus (the Microsoft term for what we prefer to call “Redmond”). It’s the ultimate repository of absolute control over the presence or absence of IPv6 on your computers. If you’ve been told you have a leaky network and that an IPv6 configuration is to blame, then you can run the relevant MSI to bring everything back down to a config that wouldn’t have looked out of place in Windows for Workgroups 3.11, with no “Teredo” tunnels, no 6-to-4s, no implied addresses...

It might be neater if this weren’t implemented by ten downloadable script files: there are only so many permutations most use cases really want to use, even in those situations

where IPv6 will be increasingly commonly found. I’m sure careful UI design somewhere in the Networking control panel could enable or disable each component instead. But hold on a second – this is all pretty advanced stuff, and it also tends to be pretty permanent. I can’t imagine why anyone would want to blithely switch network protocols on and off, having once arrived at a stable working configuration. Microsoft has chosen to deliver this suite of network control utilities in a form you can carry around on a USB key, zap a machine with, then disappear into

How to disable IPv6 or its components in Windows

Important: Internet Protocol version 6 (IPv6) is a mandatory part of Windows Vista and later versions. We do not recommend that you disable IPv6 or its components, or some Windows components may not function. Additionally, system startup will be delayed for 5 seconds if IPv6 is disabled by incorrectly setting the DisabledComponents registry setting to a value of 0x00000000. The correct value should be 0x00000000. For more information, see the “What are Microsoft’s recommendations about disabling IPv6?” question in IPv6 for Microsoft Windows: Frequently Asked Questions.

Automatically disable or re-enable IPv6 or its components

Click the **Download** button for the procedure that you want to run. Then, click **Run** or **Open** in the **File Download** dialog box, and then follow the steps in the easy fix wizard.

Disable IPv6	Prefer IPv4 over IPv6 in prefix policies	Disable IPv6 on all nontunnel interfaces	Disable IPv6 on all tunnel interfaces	Disable IPv6 on nontunnel interfaces (except the loopback) and on IPv6 tunnel interface
Download	Download	Download	Download	Download

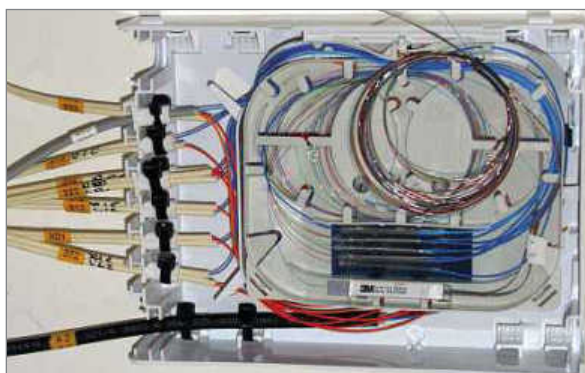
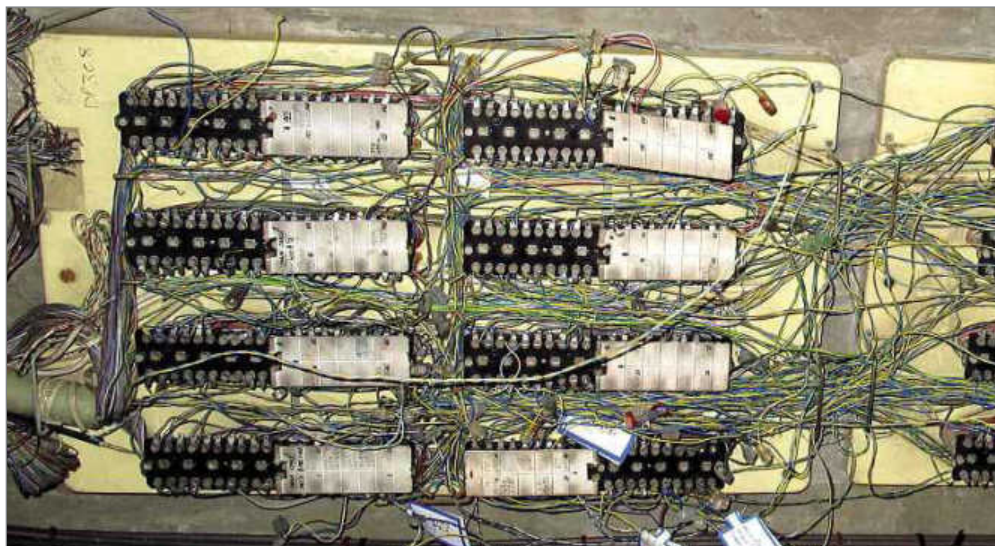
the sunset. This is a great plan for taking control, but less than great if your machine lives in a public data centre and you don't know who might have come past and turned on a long-haul IPv6 tunnel with their copy of these same utilities.

On balance, I think this is about as good as you'll get with IPv6 at the moment. It's confused and confusing; it supports good and bad guys equally well; it's likely to be used in a crisis rather than deployed in a planned manner; but it helps you make use of the knowledge and firewall capabilities you're used to, rather than plunging you deep into a scary new world. It's just what I want from a tech support resource, as opposed to four years' worth of rambling personal blogs that must be sieved through for key technical insights.

On the net at a gigabit per second

Fans of PCPro's new sister site, **Alphr.com**, may have tittered over my piece there about how an all-optical internet business has arrived in my neck of the woods and revolutionised everyone's connections. I'd been touring the bowels of the Earth and marvelling at what can be done these days with three 13amp power sockets, around 2,000km of fibre and tiny little passive light-splitters, scattered strategically throughout our estate. You can read my conclusions and the comparison between what BT could provide at pcpro.link/255sc3.

Things have moved on and I now have my connection. Getting the fibre into my property was more difficult than most installations because it turned out I had only one small iron pipe linking me to the service conduit. In this pipe already were two LLU (local-loop unbundled) lines, each of which had brought me quite expensive (allegedly "business-grade") lines from two ISPs (Easynet and Fluidata), plus a coax cable for my Freeview antenna. Even though the final customer fibre is very thin and flexible, the reinforced draw wire and probe that drags it through is a brute of a thing – everyone in the install team, me included, were gritting our teeth as the connected fibre inched its way up the pipe. I'd disconnected one of those contracts months before, but there was no guarantee that if any



damage were done it would be to that dead line. Everything was crammed in tightly, and losing my old DSL line while getting the optical delivered wasn't an option – too many clients and services still hit the incoming static IP associated with that line.

As it turned out, we got very lucky: no loss of old copper lines and an easy pull once the draw wire got out of the way. Several metres of super-thin fibre arrived in my flat and were tacked to the top of the skirting board with tiny beads of adhesive all the way to one of the standard wall boxes. A new faceplate was stuck on and a slightly thicker optical patch lead run to the new router, a Zhone GPON 2426A (read about that at pcpro.link/255sc4). Don't get too excited on my behalf, though, as the phone ports and video-streaming features aren't yet live.

My first nerdish test was to see just how fast I could download. Putting a Lenovo ThinkPad T430 on the back of the router, I went to MSDN to grab the new Office 2016 ISO images, roughly 4GB of DVD. Expecting a wait, I saw the install team out of the premises, only to get back to the laptop and discover that the 4GB image had arrived in less than 3mins 30secs. To say this looked promising would be an understatement, but I wasn't inclined to start the high-fives just

TOP Here's BT's original install from around 1947, giving DSL access at about 2.5Mbps/sec

ABOVE Fast-forward to my fibre install in 2015, with a speed boost up to a cool 1Gbit/sec

"I got back to the laptop to discover the 4GB image had arrived in less than 3mins 30secs"

yet. Rather than change my entire network range and re-password all my Wi-Fi devices to fit with the fixed configuration of the new router, I set up all my other routers to use it as their secondary connection. That way, I thought, I could just carry on running the same internal infrastructure and set those routers up to pass through the fibre router.

I really should have paid attention when I first found out that the load-balancing dialogs on my old firewalls didn't have enough noughts available to express a 1Gbits/sec connection in kilobits per second. That was just the first warning, and then those routers started crashing. The amount of data the internet could present to them would completely exceed their ability to keep moving it back into my own network. Not that this happened all that often, because as I've been trying to explain to my neighbours, the limit to your experience on the internet is not the absolute maximum speed of your connection. I hear a lot of people make comparisons based on the idea that speed-test sites and latency tell you everything you need to know, but I keep stumbling across reluctant internet users who draw the wrong conclusions. The cabbie in our nearest phone shop thought the most expensive contract would somehow buy him a better data connection than the other cabbies around him.

One neighbour repeated that error with the fibre, complaining that his new router had fewer "bars" than his outgoing BT Home Hub: that is, it was giving him a weaker Wi-Fi signal. I'd like to think that my retort, that the old Home Hub was something like 25 hops from the internet backbone whereas the fibre delivery was about three hops, somehow persuaded him of the advantage of going with the leading-edge solution.

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Futures



We explore the trends and technologies that are set to shape the future

MassChallenge

The accelerator programme helping British startups **p126**

Sex robots

Pundits predict AI will be in our bedrooms by 2050 **p127**

Geek Day Out

Find bargains at the first London Gaming Market **p128**



Inside BT's legendary research park

BT's labs have been home to a host of key innovations, including commercial fibre.

Nicole Kobie reveals what's next from Adastral Park and what it means for you

Set in green countryside near Ipswich is a former Royal Air Force base known as Adastral Park, which has been the centre of telecoms innovation for the past four decades.

An old air traffic control tower hints at its past life, but it's the BT logo on the side that reveals its current role as the base from which the telecoms giant manages half its network – and conducts groundbreaking research. More than 3,000 BT employees toil there on what the company's head of research Tim Whitley calls “purposeful innovation”.

“This is an applied engineering centre,” he said of Adastral Park.

“Making stuff that's really interesting and cool, but also making it real, and then using it to deliver some purpose – to improve the business for our customers and improve the lives of citizens. That is what gets us excited here.”

So what's stirring Whitley and his colleagues at the moment?

Beyond broadband

Last month, BT revealed plans to roll out ultrafast broadband at speeds of up to 500Mbps/sec to ten million homes by 2020. That will be made possible by a technology dubbed G Fast, pronounced “G-dot-fast”. “This is the technology that's going

ABOVE Over 3,000 BT staff work at the Adastral Park site, which controls half of UK broadband lines

to underpin ultrafast broadband networks and is right now in trial,” Whitley told *PC Pro*. G.Fast is currently being piloted in 2,000 homes in Cambridgeshire so they can have “real-world experience” with the technology, he added.

G.Fast cuts the distance between your home and the nearest source of fibre – normally your local cabinet or exchange – by rolling out to telephone poles or junction boxes closer to homes. “The breakthrough that BT had was that G.Fast didn't have to be deployed in these small units close to the house, but we could enhance G.Fast to make it deployable further back in the network,” explained

Trevor Linney, head of access network research at BT.

Not only does that mean more of your connection is fibre rather than copper, but it brings the DSLAM (digital subscriber line access multiplexer) unit closer to your home. For fibre-to-the-cabinet lines, you connect to the DSLAM – which transfers data between subscriber lines and the main backbone network – in your local street-side cabinet. G.Fast brings that handover closer to your home, boosting speeds.

All of that is essentially fibre-to-the-remote-node – extending fibre lines beyond the cabinet, but not going all the way to your home or business – but there is another aspect to G.Fast. Your data is sent over a shorter length of copper, meaning that G.Fast uses a higher frequency – at least triple that of standard VDSL2 – helping to further increase speeds.

The technology works, but the researchers at Adastral Park still have more to do. “The fundamental physics is done – so now we’re doing the standards work,” said Whitley. “We’re working with Silicon Valley manufacturers to make sure they can produce the equipment that we believe is necessary.”

■ HDR in a single stream

Thanks to contract bundling, TV is now a big part of BT’s package. Alongside intriguing new ways to deliver BT Sport – including the use of immersive hardware such as the Oculus Rift for live sports – BT is working on expanding the colour range displayed on televisions, offering more realistic shades, noted Mike Nilsson, principal researcher at BT.

The technology already exists, but you’ll need a HDR-compatible television to see the difference. BT has developed a backwards-compatible transmission standard that streams a single version of television content, so that Ultra HD televisions can deliver a picture within current colour ranges and HDR sets can “expand the same pixel values to a wider range”. That

means improved colours for those with the technology to see them, and no change for those who can’t, but all delivered via a single stream.

■ Deploying engineers by data

BT’s researchers certainly didn’t invent the notion of Big Data, but the company is harnessing others’ bright ideas to benefit the company. “What we’re doing is taking that innovation and applying it to problems relevant to our customers,” said Whitley.

Big Data is currently being used to manage the workforce in BT’s infrastructure arm, Openreach. The division uses analytics tools to deploy engineers and automatically prioritise jobs. “The bedrock of communication in the UK is the productivity of our Openreach division,” he explained. “In the past 12 months, we’ve been applying Big Data, algorithms, data science and developing tools that mean the Openreach division of BT is now doing 400,000 more jobs per year than it was 18 months ago.”

However, it’s not only Openreach engineers getting the Big Data treatment. Analytics tools are also being used to study network faults, making it easier for BT staff to diagnose and prevent problems. One such tool provides a graphical representation of all the faults on the network, grouping them together so that BT’s analyst can identify a problem with a specific Home Hub model or for customers of a certain communications provider. One researcher said that BT had seen faults fall by a fifth after the introduction of its Big Data network analysis.



ABOVE An old control tower emblazoned with the BT logo offers a clue about Adastral Park’s military past

■ Unhackable data

While we were touring the Adastral Park site, BT announced another major breakthrough. In conjunction with Toshiba Research and German optics firm ADVA, BT researchers have devised a way to make quantum distribution keys work over fibre networks, without hurting the data being transmitted or warping the keys – a problem BT’s researchers have been battling for decades.

The encryption keys are stored on photons, and it’s impossible for a hacker to conceal any “fiddling” with them. According to Tim Whitley, that means that “security is guaranteed by the laws of physics”. If any of the quantum keys have been disturbed, the data can simply be chucked. This process effectively renders networks using the tech “impossible to hack”, said Andrew Lord, head of optical research at BT and visiting professor at the University of Essex.

Whitley said the quantum distribution key technology could be rolled out across BT’s networks within a decade. ●

40 years of Adastral Park



When BT first took over the former Royal Air Force site in 1975, it was called the Post Office Research Station, and was used to develop innovations in postal sorting. Times have changed. The name shifted to BT Labs and was later dubbed Adastral Park, after the RAF’s motto *per ardua ad astra*, or “through adversity to the stars”. Its work reflected the growing role of telecommunications.

“We manage about half of the broadband lines in the UK from this centre, and most of the global networks – BT is the most extensive global operator in the world,” said head of research Tim Whitley. “We have an operations centre here, sitting cheek and jowl with our innovators, for a very good reason – because if you’re trying to get innovation out of the lab and into the real world, it’s good to have people who are in that real world.”

He judges the lab’s success by the amount of patents it produces and the investment BT ploughs into it. Adastral Park has published 4,560 patents, adding hundreds every year, ranking third in the UK after Unilever and Rolls-Royce. BT has invested £2.8 billion in the past decade, again making it third in Britain for R&D, after two pharmaceutical firms.

While Adastral Park has been home to many innovations, Whitley pointed to one in particular. “The world’s first ever commercial single-node optical fibre system was not in some far-flung land, it was between the exotic locations of Luton and Milton Keynes,” he said, speaking of what we now refer to as fibre. Not invented by BT, but made viable by its work.

“The engineering task of deploying this stuff and making it and installing it, was thought to be impossible,” said Whitley. “It was this lab, in the late 1970s and early 80s, that nipped it away through all those engineering challenges. And that’s why the world’s first commercial system went live here, and not another country.”

That’s something to be proud of: “I do find it inspiring, the degree to which that innovation in the early 80s, here in this lab, powers our modern connected world,” he said.





Q&A MassChallenge aims to improve British startups

Startups need support, but not only to win investment. MassChallenge founder and CEO John Harthorne reveals how his startup accelerator programme is helping UK entrepreneurs realise their full potential

THERE'S MORE TO tech startups than so-called "unicorns" – companies that are quickly valued in billions of dollars. They can also have a social impact, which is what John Harthorne is encouraging with MassChallenge. The startup accelerator has been based in Boston for the past five years, but extended to the UK for the first time this autumn.

Accelerators are designed to spur startups – either through funding, mentorship or other assistance – and normally take a slice of equity for doing so. Harthorne's MassChallenge is different. It offers £500,000 in funding, but takes no stake in the 90 firms it backs. Indeed, while it's helped startups find millions of dollars in investment, its real focus is on ideas with a social impact.

We spoke to Harthorne at MassChallenge's London headquarters in Tobacco Dock, Wapping, to find out why startups are better together and why money is less important than contacts.

Q What do you offer startups?

A We use a competition framework. In Boston, we give away a million dollars in cash prizes. In the UK, we give away £500,000. That's the attraction – all the startups want money. They all think that funding will solve their problems, especially at the early stage. It turns out that's not true, and it's not a ton of money anyway.

They get four months of free stuff such as airline miles and software packages. Our goal is to act like their concierge and bring them whatever they need. If they say, 'Dyson is my customer – I need to talk to its head of innovation,' then we'll go and try to find a way to figure out who that is, get their contact info and set up a meeting for the startup. We'll try to hook them up with whatever they want, whoever they want.

We'll try to get them a press and media opportunity, team members or funding. And we have over 200



BELOW More than 200 mentors support the fledgling startups

BOTTOM The UK HQ in Tobacco Dock, Wapping

mentors who volunteer to support the teams.

Q What are you looking for in a startup?

A Our criteria is not the same as a typical accelerator model. We are looking for high-impact startups. They can be non-profits. It doesn't have to be an investable company or even a profitable company. It's something that's going to change the world in a really positive way. That might also be a very profitable pharmaceutical company, or an education company, or a social-impact company that's feeding hungry people in a new way that's innovative and different.

Q How important is it to have startups all in one place?

A A lot of our teams have never actually been able to work together because London is too expensive.

Now, for the first time, they've been working together and they have made incredible improvements.

To help that, the open floor plan is really important for startups. They know so little and are so alone – like little orphaned babies trying to figure everything out on their own. And the only real way to do it is

to work together as a bigger group. And so they have to talk to each other. One team will learn one lesson before the other team does, and then they can swap knowledge.

Q The average age of your founders is higher than expected, in the mid-thirties. Why is that?

A Startups are easier to do when you're young, because you don't have a family. It's a financially risky, very time-consuming and difficult thing to do. But you're better at it when you're older, because you're smarter and more experienced.

The economic crisis has helped to bring in people. You have young people graduating from university who can't find jobs, so they have to create their own. And then you have people at more established companies such as Oracle, Microsoft or IBM, who are either losing their job or are frustrated that they're not able to operate with freedom or do what they want. They can reinvent their life again and reconnect their business to their soul.

I would say that's probably the main advantage of the startup. It's the closest you get to expressing yourself in the form of a business. In most larger corporations you're doing somebody else's work. You're more of a cog in somebody else's machine. ●



Sex drive: why robots might press your buttons

Improvements in AI and robotics have pundits predicting sex will shift to robots by 2050

Robots will be in our bedrooms by 2050. That's according to futurologist Ian Pearson, who predicted sex with robots will be more popular than with humans in 35 years. Although the report was commissioned by a sex-toy company and futurology is no more a precise science than astrology, he's not the only one worried about the prospect of computerised copulation.

Japanese firm SoftBank has even told owners not to have "relations" with their Pepper robots. "It tells us something about the imagination of sex today," said Dr Kathleen Richardson of De Montfort University, who leads the Campaign Against Sex Robots. "It tells us that technology is driven by some dark notions of the human."

Disturbing model

These robots could replace prostitutes or be used to treat paedophiles. But Dr Richardson doesn't think the "inspiration for the making of sex robots" should be found in "the relations between the buyers and sellers of sex and child abusers". If this were the case, then "sex robots show a disturbing desire to normalise abuse".

She also argued that it's dangerous to replace human interaction with machines. "We are human because we live in relation with other humans," she told *PC Pro*. "When people don't have relations with others, it's a nightmare. That's why there's so much depression, mental-health issues, fertility issues in very wealthy countries – because commodities can't meet all of our needs."

Dr Richardson's group first

called for a ban on sex with robots, but has since stated its aim is to raise awareness. It's a better tactic, according to Dr Kate Devlin of Goldsmiths, University of London. "I think a knee-jerk ban of any new technology is misguided," she said. "We should see it



ABOVE Future sex robots probably won't look like Pris from the film *Blade Runner*

as an opportunity to explore and discuss. That can be done without banning development, because there's no way we're near reaching the potential of such technology."

Human form?

If you're picturing a hi-tech blow-up doll or Pris from *Blade Runner*, think again. "Humans tend to anthropomorphise," said Devlin. "There's absolutely no reason why a sex robot has to look like a human."

We should also consider what AI could add. "Humans are still uncovering a lot about how sex influences the way we think and behave," she said. "It's intrinsic to being human, but it doesn't appear much in research when modelling cognitive systems. Examining gender and sexuality in terms of these robots is an interesting area."

In other words, AI robots might learn what we want in the bedroom, but they may also help us learn why we desire it.

Crowdfund this!

Our pick of UK tech projects on Kickstarter and Indiegogo

MySpotIs Pocket GPS Co-ordinates Locator

I'm lost. Why do we need this?

Sure, thanks to Google Maps and smartphones with GPS, being lost isn't a familiar

sensation when out and about in town.

But what about when hiking up a mountain? Or

cycling down a forest trail? A turned ankle or nasty fall could leave you needing to share your location, but directions aren't always simple. You might know you're somewhere in the New Forest, but "I'm next to some trees" isn't quite as precise as emergency services require.



So this widget will pinpoint which tree you're lying next to?

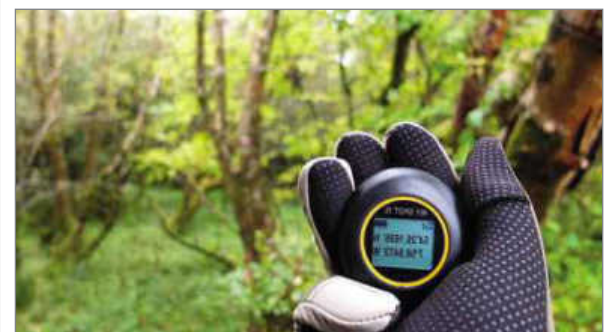
Exactly. Tap the Locate button and your GPS co-ordinates are shown onscreen. As the MySpotIs doesn't have a cellular connection, you'll still need to text or call for help, but those co-ordinates can be tapped directly into a satnav, showing your location within ten metres, at which point your rescuers will probably hear your screams.

That's a niche gadget. It really is, but you can also use it to time and track your route, record exact locations of points of interest, navigate via a digital compass, and check the time. The MySpotIs also comes with a key chain, handy for keeping it with you permanently, so you need never be without a precise GPS location.

Can you use it to find your keys? Sadly, no. There's no connectivity, so you can't ping the MySpotIs to find it. That means you can't ask it where you've left your keys and, after your accident in a remote area, you need to be conscious enough to hit the button and then call for help. While connectivity would be a killer feature, the upside is that the limited function means the MySpotIs only requires a pair of AAA batteries for power.

Will this get backed? Tough call. Enniskillen-based developer Simon Davidson is asking for £12,500 but, at the time of writing, hadn't made much of a dent in that goal. The early-bird price for the pocket GPS is £40, while the full price is £49. Davidson is promising it will ship in March next year.

Link: pcpro.link/255myspotis





Geek Day Out: London Gaming Market

Find classic console titles and the latest board games at London's new regular market

Hankering for a console game from your childhood? You could turn to eBay, but if you're looking to relive wandering from market stall to stall flipping through boxes of cartridges, mark 15 November in your calendar.

That's the date of the first London Gaming Market, but don't panic if you've missed it, as it will be held every four months in the capital, near Russell Square.

"This event is the first of its kind in London and is aimed at collectors and fans of all things gaming," said Rebecca Hirst of gaming company Replay. It's not the first such market in the UK, but the capital has been oddly bereft of a regular event, meaning Londoners must wait for gaming events or conferences, or head to Leeds for its annual show.

However, the appetite for retro classics has justified an event of its own. "As organisers of multiple gaming events across the UK, our research has shown that there is a demand for a low-cost opportunity for collectors to shop in London," said Hirst. "Most of our team are passionate collectors themselves, so we are delighted to provide this show for the gaming community."

“ Selling isn't just restricted to the shops and traders – anyone is welcome to take a table and sell their games ”

By "games", they don't only mean old-school PC games or cartridges for ancient consoles. The market will also include board games, cards and merchandise. While there won't be playable video games set up at the first run of the market, there will be an "unplugged gaming" demonstration area with free-to-play board and card games.

"A variety of games will be available to the players and we attempt to cater for everyone's interests," Hirst added. "We expect to have all kinds of weird and wonderful gaming items. These will vary from rare early retro games, through to the latest limited editions."



ABOVE The London Gaming Market will be held at the Royal National Hotel near Russell Square



LEFT All kinds of weird and wonderful gaming items will be up for sale

With the focus on retro games, younger generations may be left slightly bewildered. "It's difficult to pinpoint an age group, because the traders will cater for such an expanse of decades' worth of products," said Hirst. "So technically, [it's suitable for] almost all ages, but there may be more for the nostalgic generations."

If you have games of your own clogging up your garage or loft, you could earn a few quid. "Selling isn't just restricted to the shops and traders – anyone is welcome to take a table and sell their surplus games," said Hirst. "We would love anyone who maybe has their own shop, eBay shop or even just individuals. The more the merrier."

The first London Gaming Market is on 15 November at the Royal National Hotel, near Russell Square, and will be held again on 6 March and 3 July next year. Admission is £5 or £2 for the afternoon; children under 14 go free with an adult. More details can be found at londongamingmarket.com ●

What are... carbon nanotubes?

IBM believes chips could shrink to 1.8nm thanks to a breakthrough that will replace silicon transistors with carbon nanotubes. Here's what that means

The conventional way to boost chip speeds is to shrink them. Intel's latest roadmap states that semiconductors using the 10nm process will arrive by 2017, keeping Moore's law on the technology statute book for at least another couple of years.

However, the long-term prospects of Gordon Moore's prophecy are under threat, as the silicon transistors used in chips today will soon hit their limits. Intel has already stretched its release "cadence" from two years to two and a half, as it struggles to shrink the process even further.

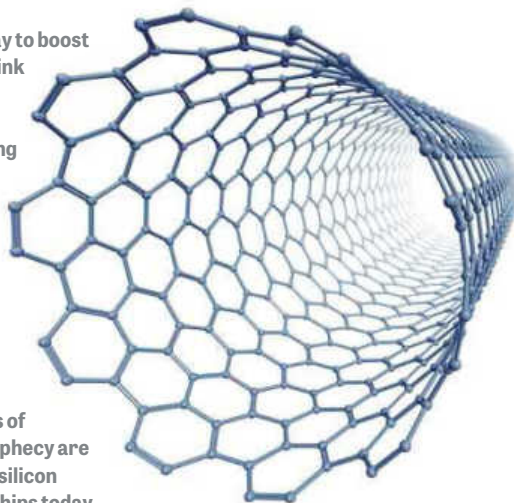
Moore's law now hinges on a replacement being found for silicon. IBM believes that could be carbon nanotubes, with a paper in *Science* revealing a major breakthrough that could eventually replace silicon transistors.

What are carbon nanotubes?

To make a carbon nanotube, simply take single-atom-thick sheets of carbon and roll them into tubes – it's essentially a reinforced version of graphene. Ta-da, you're a materials scientist. Of course, it's easier said than done, and manufacturing is a problem. However, the tiny tubes can be used to make small transistors for use in chips for miniscule devices. Plus, carbon nanotubes require less energy to switch state than silicon, so devices using the technology require less power.

And what has IBM come up with?

IBM's researchers have found a new way of connecting carbon transistors to contacts, which are valves that manage the flow of electrons into the semiconductor. The smaller the contact, the larger the electrical resistance, which slows everything down. That led to a performance bottleneck at sizes below 10nm. Researchers have found a way to chemically weld carbon nanotubes to the metal atoms of the contacts using molybdenum, which allows their size



to be shrunk along with transistors, without hurting performance.

So welding is cutting-edge science now?

If the welding sounds rather unimpressive, remember it's on a microscopic scale. IBM has managed to weld carbon nanotube to contacts measuring 9nm. Not quite the same as fiddling with a soldering iron.

How tiny are we talking? IBM has previously unveiled a 9nm carbon nanotube transistor, but the latest breakthrough takes it down to 7nm – with the potential long-term ability to shrink as small as 1.8nm, keeping Moore's law ticking for many years to come. For comparison's sake, Intel's latest Skylake chips are made on a 14nm process, with the next generation shrinking to 10nm. To put that into a vaguely understandable sense of scale, 10nm is about 10,000 times thinner than a human hair.

How long until chips go carbon?

Chips will be made from silicon for many years to come. To make the switch to carbon nanotubes happen, IBM must figure out how to purify carbon so that only semiconductor molecules are left, and how to better work with nanotubes to transform them into chips. Then, when it's ready, production factories can be built and devices can be designed to use the new chips. Those hurdles aside, IBM believes carbon nanotube technology could be in use within the decade – and it's investing \$3 billion to develop this "post-silicon" future.

Best of **alphr.com**

Our sister site Alphr covers the latest in tech and science – here are the top stories from this month on the innovations that are just over the horizon.

Marketing to an audience of one

Advertising is about to get more personal, thanks to the Internet of Things, facial recognition and data analytics. Smart cameras could watch shoppers, judge their mood and guess their clothing brands, all in order to suggest personalised advertisements – but without knowing the shopper's real identity. The hope is that stores could make product recommendations and gather marketing data to build up a profile of a shopper without losing their trust.

pcpro.link/255alphr1



Kickstarting a moon shot

Chris Larmour is trying to send a rocket to land a small payload on the moon – and it's all thanks to crowdfunding. If successful, he'll send a 22-ton rocket with a small payload in a titanium "spike", which will penetrate the surface of the moon. Larmour is raising funds for the project on Kickstarter. That said, at the time of writing, he was a fair bit short of the £600,000 goal, and admits further investment will be needed to get the project off the ground. As such.

pcpro.link/255alphr2



A different type of road charge

Rather than boost car battery sizes to increase their driving range, we should shrink them – letting them charge more quickly while on the go. That's the idea Qualcomm is suggesting to solve one of the major issues facing electric cars, saying it's hoping to embed a version of its wireless charging technology into road surfaces. While the idea is already being trialled, it will take at least 15 years before it can be widely used on roads.

pcpro.link/255alphr3





The practical reality is that launching a new phone is a supply chain nightmare, says **Jon Honeyball**

Apple's recent "Chipgate" scandal, where the battery life and power of an iPhone 6s was allegedly linked to which company made the processor, is fascinating: it's rare for the grubby inner workings of the production process to come to the attention of the public, Volkswagen notwithstanding.

The practical reality is that launching a new phone is a supply chain nightmare. Apple does such a good job of keeping everything under wraps, and ensuring its supply chain does the same, meaning that it's incredibly hard to know precisely where a new model is in terms of development.

I've heard rumours that the manufacturing partners only get the final details a few weeks before launch, and then go into a total frenzy to build as many as possible in the remaining time. This might be true, but leaving everything to the last minute is extremely risky from a design point of view, and from a regulatory one too. At least, it would be for a normal company: Apple has its own radio-interference test labs, for example, and can do its own certification to all the international standards, simply because its labs are as well equipped as any in the world.

No, the question surrounding the supply chain is how quickly the vendors ramp up, and how soon they can produce the mind-bending quantities of components required. Remember that Apple doesn't make anything itself. Chipgate brought to light that Apple's iPhone 6s CPU was manufactured by two different companies using slightly different processes and methodologies. But this isn't surprising. Apple has a formidable CPU design team, as good as any in the world, but it has to work with vendors such as TSMC and Samsung to actually create the silicon.

The same is true for display panels. These are bought in from various suppliers, and if you look very carefully at a lot of Apple products side by side, you will see variations that are simply down to which supplier's screen is in that particular device. And different suppliers might well be at different places on their supply chain ramp-up, both in terms of performance and yield.

That little word "yield" is the absolute killer of the leading-edge electronics manufacturing

world. There is no point having a production line that can create 100,000 displays a week if half of them are poor. Who sets the reject level? Rarely is there an absolute spec that must be met. Instead, it's more a case of "it must be as good as this minimum level". As production volume ramps up, the yield usually improves as the process settles down and the wrinkles are ironed out.

The cold, hard reality is that those initial months of production are terrifying for a manufacturer, as the thousands of components come together from dozens, even hundreds, of suppliers, in a rush to get the product out of the door and ready for launch. These launches have a significant impact on the shipping companies, too. Rumour has it that, at the iPhone 6 launch, all of the cargo planes out of China were booked solid for a fortnight just shipping out the new phone. The scale of these things is scary.

So are you better off waiting a few months for things to settle down? It might seem so, but there are other factors that will come

“Rumour has it that all the cargo planes out of China were booked solid for a fortnight just to ship the new phone”

into play over time. For example, the display manufacturer might find a way of tweaking the production process to shave a few cents off the cost, with the product still meeting spec. This sort of ongoing cost optimisation is critical to the profitability of these companies. It's entirely possible that a display made six months into the process is not quite as lovely as the one made at the beginning. Or it might be better. But only if you get the phone with

the display from Supplier X, rather than Supplier Y. And no, you definitely can't tell from the outside which it is.

As for Chipgate, sure, there are tools that can show differences when you get your phone to do stupid things. When you use it like normal people, the consensus appears to be that any differences are down in the noise. Try that with other vendors such as Samsung, LG and Nokia, and I think you'll find the same thing. This level of production engineering is simply mind-boggling and out of the comprehension of the average consumer.

To be blunt, it's a miracle that any of these things work at all. That's why I wasn't surprised that Steve Jobs' replacement was the guy who managed to run the manufacturing supply chain, given how totally critical it is to Apple's operations. If Chipgate teaches us anything, it's the wisdom of appointing Tim Cook.

■ Jon Honeyball is contributing editor of *PC Pro* and would like to think he was made on a good day. Others will doubtless disagree. Email jon@jonhoneyball.com

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